

**SCIENCE ABSTRACTS: SECTION B**

**5292-5944**

# **ELECTRICAL ENGINEERING ABSTRACTS**

**Published by The Institution of Electrical Engineers**

# Electrical Engineering Abstracts

## SECTION B OF SCIENCE ABSTRACTS

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Dielectric theory	Ion emission	Hearing
Conduction theory	Electrical properties of solids	Luminescence
Magnetic theory	Magnetic properties of solids	Colour theory
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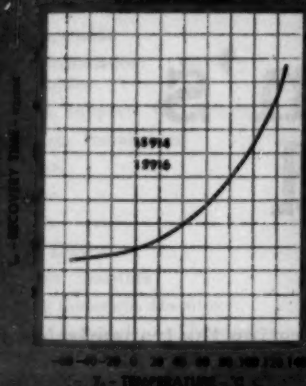
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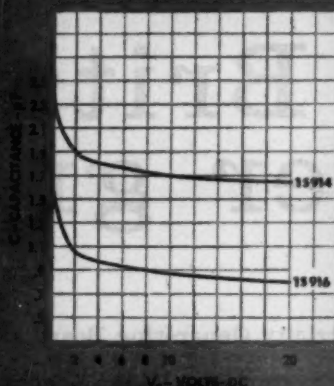
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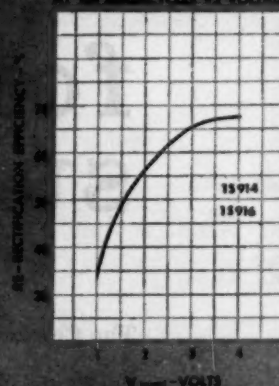
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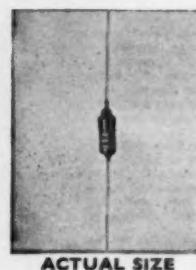
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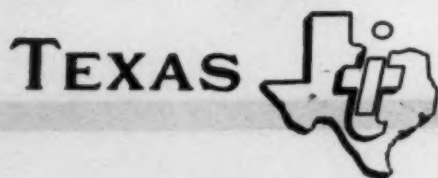


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# ELECTRICAL ENGINEERING ABSTRACTS

Volume 63

SEPTEMBER 1960

Number 753

## GENERAL

(For abstracts on circuit theory see also  
Lines - Networks - Filters)

- 5292 CLINICAL-STATISTICAL OBSERVATIONS OF 361  
CASES OF ELECTRICAL ACCIDENTS. 614.825  
A.Lambusta and G.Catalano.  
Ingegn. Ferroviaria, Vol. 15, No. 3, 211-14 (March, 1960). In  
Italian.  
The accidents investigated involved personnel of the Italian  
State Railways, mostly staff working on lines using electric traction,  
but with a small proportion of workshop personnel. Of the total  
number of accidents, 109 were fatal. The power causing the accidents  
ranged from 90 to 3600 V d.c. and 125 V to 130 kV a.c. at 16 to 50 c/s.  
Some of the secondary injuries and effects resulting from electro-  
cution are described and analysed. 22 references.
- 5293 NEW TEST RESULTS ON THE INTRINSIC SAFETY OF  
ELECTRICAL APPARATUS AND PLANT. G.Frey. 621.3  
Elektrie, Vol. 14, No. 4, 115-20 (April, 1960). In German.  
In a previous article [Dtsch. Elektrotech., Vol. 12, No. 10, 352-8  
(1958)] the problem of intrinsic safety in explosion-proof apparatus  
was based on the free energy of the arc. Further tests have shown  
that more practical results can be obtained by oscillographic measure-  
ments of the current flowing after making and before breaking the  
circuit. These tests are described and technical bases are laid down  
for a large number of types of apparatus in a variety of explosive  
mixtures. It is found that the new technical bases differ from those  
in the previous article. R.G.Jakeman
- 5294 DIMENSIONLESS PHYSICAL QUANTITIES 621.3.01  
[VERHALTNISGRÖSSEN]. A.Hochrainer.  
Elektrotech. Z. (E.T.Z.)A, Vol. 81, No. 8, 305-9 (April 11, 1960).  
In German.  
A discussion of physical quantities and their relation to units  
and dimensions. In particular, quantities which are really the ratio  
of two similar physical quantities and are disguised as pure num-  
bers or dimensionless quantities, called by the author "Verhältnis-  
größen", are described. They possess the essential characteristic  
of a physical quantity, namely invariance to change of unit. S.Weintroub
- 5295 DEVELOPMENT OF THE FORMULAE OF ELECTRO- 621.3.011.1  
MAGNETISM IN THE M.K.S. SYSTEM. P.Vigoureux.  
Proc. Instn Elect. Engrs, Paper 3012 M, publ. July, 1959 (Vol. 107B,  
331-6, 337-40).  
Republication, with discussion, of the paper already abstracted  
as Abstr. 4446 of 1959.
- 5296 ON THE VALIDITY OF THE EQUATION CURL 621.3.012  
CURL  $V = \text{GRAD DIV } V - \nabla^2 V$ . F.Müller.  
Hochfrequenztech. u. Elektakust., Vol. 69, No. 2, 62-7 (April, 1960).  
In German.  
A unified definition of the vector operators entering into this  
equation in arbitrary coordinate systems with vanishing curvature  
tensors, is established by the use of tensor formulation in Riemann's  
geometry. J.K.Skwirzynski
- 5297 THE INTERPRETATION OF CHARACTERISTICS AND 621.3.013  
OF FUNDAMENTAL EQUATIONS OF THE ELECTRO-  
MAGNETIC FIELD. G.Fodor.  
Periodica polytech. Elect. Engng, Vol. 3, No. 3, 197-215 (1959).

Electromagnetic fields in vacuum may be defined solely by the  
electric field intensity vector  $E$  and the magnetic flux density  
vector  $B$ . The same quantities describe the field also in continuous  
media if the material is represented by bound charges and currents.  
However this representation is too general to be useful even in the  
analysis of very simple problems. The introduction of the well  
known electric displacement vector  $D$  and the magnetic intensity  
vector  $H$  becomes very desirable. The question of the independent  
existence of these latter vectors is investigated and the conclusion  
made that the  $D$  and  $H$  vectors are vector potential-like quantities  
which are not unequivocally determined by the defining equations.

K.Erdélyi

621.3.013.2

5298 FLUX DISTRIBUTION IN A PERMEABLE SHEET WITH  
A HOLE NEAR AN EDGE. B.V.Jayawant.  
Proc. Instn Elect. Engrs, Monogr. 368M, publ. March, 1960  
(Vol. 107C, 238-41, Sept., 1960).

Republication of the Monograph already abstracted as Abstr.  
1974 of 1960.

621.3.031 : 621.319.7

5299 ELECTRIC AND MAGNETIC IMAGES. 621.3.031 : 621.319.7  
P.Hammond.  
Proc. Instn Elect. Engrs, Monogr. 379, publ. May, 1960 (Vol. 107C,  
306-13, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr.  
3926 of 1960.

## POWER RESOURCES PRIME MOVERS

- 5300 LIQUID METAL COOLED REACTORS. 621.039  
H.Chilton.  
Elect. Rev., Vol. 167, No. 2, 47-52 (July 8, 1960).  
The use of various metals in experimental or prototype reactors  
is described, with some of the engineering considerations involved.
- 5301 EXPERIENCE GAINED WITH THE SIEMENS ARGONAUT 621.039.421  
REACTOR. W.Humbach.  
Siemens-Z., Vol. 34, No. 4, 197-8 (April, 1960). In German.  
Since the essential data of a nuclear reactor cannot be calculated  
with sufficient accuracy, Siemens have built their own reactor for  
development purposes. Since June 1959, this reactor has been used to  
determine experimentally the minimum fuel quantities required  
with various arrangements of the fuel elements. Experimental  
checks have also been made on the calculations for radiation pro-  
tection and investigations successfully completed into the measuring  
and control system of a power reactor which is in the planning stage.
- 5302 COMPARISON OF CHEMICAL AND ELECTRIC PRO- 621.455 : 621.384 : 525  
PULSION SYSTEMS FOR INTERPLANETARY TRAVEL.  
C.Saltzer, R.T.Craig and C.W.Fetheroff.  
Trans Inst. Radio Engrs, Vol. 46, No. 4, 465-76 (April, 1960).  
The basic mission parameters which are required for the  
evaluation of engine performance for interplanetary flights are  
defined. The engine parameters are also defined, and the relation  
between these parameters is formulated. The possibility of  
achieving much larger payload fractions by the use of electric pro-  
pulsion systems, as opposed to the use of chemical propulsion



systems, is indicated. Methods of calculating impulsive orbit transfers between circular orbits, escape and entry from satellite orbits using low thrust, and optimized powered transfer between heliocentric orbits are given.

621.455 : 621.384 : 537.56

### 5303 A COMPARISON OF ION AND PLASMA PROPULSION. S.W.Kash.

Proc. Inst. Radio Engrs, Vol. 46, No. 4, 458-65 (April, 1960).

Several important features and parameters of ion and plasma accelerators for propulsion are compared. Estimates for the thrust of individual ion and plasma acceleration units are given. Impulse measurements for a collinear electrode plasma accelerator are presented. The maximum thrust for an ion gun does not depend on the diameter of the beam, but primarily on the accelerating voltage. Because of the relatively small thrust of the ion accelerator, a greater number of them will be required for a given total amount of thrust. Estimates indicate that the ion accelerator may be somewhat more efficient; however, further experiments are needed to determine the efficiency of both types of accelerators. Beam neutralization is a problem peculiar to the ion accelerator. Considerable research and development may be necessary to provide a satisfactory method for neutralizing the ions. An estimate of the power for neutralization is made. The variation of efficiency with specific impulse is discussed. Further experiments are needed to determine the most efficient ranges of specific impulse for both types of accelerators. Erosion is a serious problem in electrical propulsion; however, for a plasma accelerator it may actually be utilized to provide the propellant material.

## POWER SUPPLY POWER STATIONS

621.311.1

5304 RELATIVE FORECASTS OF THE DEMAND FOR  
PRIMARY ENERGY IN BELGIUM DURING THE  
COMING TEN YEARS. R.van Mele and C.Marique.  
Bull. Soc. Roy. Belge Elect., Vol. 76, No. 1, 27-35 (Jan.-March,  
1960). In French.

A statistical review of the production of coal and petroleum products. It is expected that the demand will continue to increase substantially during the coming 10 years.

R.G.Jakeman

621.311.1

### 5305 WHAT IS THE COST OF SYSTEM LOSSES? K.Theilssiefje.

Elektrizitätswirtschaft, Vol. 59, No. 7, 179-84 (April 5, 1960).  
In German.

Describes a method which makes it possible to establish the cost of system losses in unit time, as well as the cost of the energy losses of the system. Brief consideration is given to losses under optimum conditions of distribution. The expressions governing the maintenance of frequency in non-optimum conditions are set out, and the cost of the losses is then considered. They are shown to be independent of the optimum for each type of load distribution. A simple example of how to calculate the total cost of the annual losses in a network is given by way of illustration. The calculation is applicable to any type of system operation. Any type of optimum calculator, such as the "Sielomat", can be used as an aid towards solving the problem.

E.W.Golding

621.311.1

5306 ELECTRICITY SUPPLY IN ØSTLAND (NORWAY).  
Tekn. Ukeblad, Vol. 107, No. 17, 360-5 (April, 1960).  
Also in Elektrotek. T., Vol. 73, No. 12, 197-206 (May 5, 1960).  
In Norwegian.

An abridged version of the annual report on the interconnected system for 1958-59. The distribution of storage capacity among the various hydro-electric installations is shown diagrammatically, the total capacity amounting to 7716 GWh, 2423 GWh of this being taken up by industry. Maximum load which occurred in November was 2101 MW, 8% higher than in the previous year. The weekly power consumption is plotted for the various types of consumer: heavy industry, electrode boilers, domestic and light industry, and railways. Fault activities are analysed, showing the generation loss they caused. New generators with 315.7 MVA total output were installed during the year.

G.N.J.Beck

### 621.311.1 STRATEGY FOR EXPANSION OF UTILITY GENERATION.

5307 D.N.Reps and J.A.Rose.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1710-20 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

See Abstr. 3941 of 1960. A technique is presented for evaluating the effect of cost estimate error and load forecast error on the choice of optimum system expansion plan. The technique shows that more accurate estimates of future loads and costs can save as much as 10% in system investment. There are four steps: (a) the formulation of several alternative policies for system expansion; (b) the selection of one or more alternative system-expansion patterns to satisfy each policy, (c) calculations by operational gaming methods to obtain the system expansion plan based on each pattern (i.e. the time scale of implementation); and (d) a study of the alternative plans and their costs to decide on the best strategy. Examples are given of the various stages with the particular point being brought in that some of the estimates of future growth etc., may not be accurate. Various alternative estimates can be considered simultaneously, each being assigned a probability.

G.A.Montgomerie

621.311.1

### THEORY OF ECONOMIC SELECTION OF GENERATING

5308 UNITS. K.L.Hicks.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1794-800 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Changes are taking place in the structure of the electric supply industry which require reassessment of the methods of selecting new generating capacity. It is considered that the "peaking-station" approach can be widened to include types of plant intermediate between base-load and peaking sets. Simple formulae are derived whereby the optimum size and type of set can be selected. The results have been checked against more elaborate methods in relation to a number of large American utilities.

A.P.Wilmshurst

621.311.161

### 5309 CALCULATION OF LOSSES ON AUTOMATIC DISTRIBUTION OF REACTIVE LOAD BETWEEN POWER STATION GENERATORS. L.V.Rosman.

Elekt. Stantsii, 1959, No. 6, 33-8 (June). In Russian.

In developing grouped excitation control systems for the generators of a power plant it becomes necessary to evaluate the additional losses which occur when reactive load distribution conditions depart from the optimum. The present investigation of such optimum conditions indicates that they are not identical for different systems and depend on the resistance values of generator and transformer branches. In practice wide deviations from the optimum distribution are permissible.

Central Electricity Generating Board Digest

621.311.161 : 621.316.728

### 5310 RESULTS OF NEW CIRCUIT-BREAKING TESTS IN THE WESTERN EUROPEAN POWER NETWORKS FOR THE DETERMINATION OF REGULATION PARAMETERS.

Elektrizitätswirtschaft, Vol. 59, No. 4, 89-92 (Feb. 20, 1960).

The 1957-58 annual report of the U.C.P.T.E. described tests which members of the Union had carried out to verify the regulation characteristics of the interconnected networks. In the conclusion of the report, "Importance and determination of the performance figure and degree of regulation in the Western European interconnected networks", further tests were called for so that statistical methods could be used to obtain more accurate conclusions. This paper, based on the Union's 1958-59 report, describes the various switch-off tests carried out by the Bayernwerk and the Austrian Supply Authority. Detailed results are presented in tabular and graphical form. The importance is reiterated of carrying out still more tests. Results available at present are not yet adequate to draw accurate conclusions from a statistical analysis.

E.W.Golding

621.311.161 : 621.314.2

### 5311 TRANSFORMER IMPEDANCE MATCHING.

G.W.Biff and F.A.Allehoff.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1791-4 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Surveys the problem of impedance matching to ensure sufficiently equal division of load in paralleled power transformers. Suggests that the present tolerance allowed on nominal impedance



(in U.S.A.) should be reduced to  $\pm 5\%$  with suitable limitation of variation through the tapping range, and quotes data to show this would be practicable in manufacture. M.R.Dickson

621.311.176 : 621.316.925  
GENERATOR PROTECTION IN BASE POWER STATIONS. See Abstr. 475c

621.311.2  
5312 COMPLEX AUTOMATION OF NEW UNIT-TYPE POWER STATIONS. M.A.Duél'.  
Elekt. Stantsii, 1959, No. 10, 10-15 (Oct.). In Russian.  
Some of the problems to be solved in the automation of 100 to 300 MW stations are considered.

621.311.2 : 681.142  
APPLICATION OF COMPUTERS IN PLANNING HYDRO-THERMAL GENERATING SYSTEMS. See Abstr. 5284

621.311.2/4 : 621.316.57  
5313 SELECTOR CONTROL FOR POWER-STATION AND SUBSTATION CONTROL ROOMS.  
H.Pestel, E.Bartels and G.Kloss.  
Elekt. Vol. 14, No. 2, 35-41 (Feb., 1960). In German.

Describes a system where a limited number of operating buttons are used to control circuit-breakers chosen through illuminated selector switches. Combined with physical separation between indicating panel and control desk this provides a very compact arrangement at 220 V. Further space reduction is expected using communication techniques and operation at a lower voltage. P.Linton

621.311.21  
5314 KARIBA POWER SCHEME.  
Engineer, Vol. 209, 806-12 (May 13, 1960).

This is a brief summary of this scheme written after the completion of the dam and the installation of the first two sets [see also Elect. Times, Vol. 137, 751-7 (May 12, 1960)]. Model studies were carried out on dam design, flood gates and turbine intakes. Despite the flood damage the work was completed at less than the estimated cost; when the entire scheme is complete (about 1972) the cost for 1500 MW capacity is expected to be £80/kW. P.Linton

621.311.21 : 621.316.728  
5315 ELECTROHYDRAULIC GOVERNORS AT BEECHWOOD GENERATING STATION.  
P.G.Fazzari and G.H.D.Ganong.  
Engng J., Vol. 43, No. 2, 35-40 (Feb., 1960).

These two 36 MW sets represent 23% of the New Brunswick supply system and will be used for peaking and frequency regulation during low river flow, and as base plant during high-flow periods. At a later stage of system development the station will probably operate under tie-line control with or without frequency bias. This flexibility is achieved by using the A.S.E.A. electrohydraulic governor comprising permanent-magnet generator, tuned LC circuit and electronic amplification to an opposed-windings solenoid operating the hydraulic pilot valve. Special features include single-point control over both machines, adjustable load sharing and damping, and transition from spinning reserve in air to full load within 6 seconds. P.Linton

621.311.21  
5316 THE EXPERIMENTAL TIDAL POWER STATION AT SAINT-MALO. L.Kammerlocher.  
Rev. gen. Elect., Vol. 69, No. 5, 237-61 (May, 1960). In French.

This is a report on the first results obtained from the experimental 9 MW 5.65 kV fully-immersed unit. Full details of the installation are given, together with the latest design changes. A comparison with extensive model tests provides accurate estimates of the scale effect which is more favourable than had been assumed in the Rance project. Considerable experience on corrosion problems has been obtained. P.Linton

621.311.21  
5317 THE MAVUZI HYDROELECTRIC POWER STATION IN PORTUGUESE EAST AFRICA K.Junker.  
Siemens-Z., Vol. 34, No. 4, 194-6 (April, 1960). In German.

The Mavuzi hydroelectric power station in Mozambique is the largest power station in the country. A description is given of the plant and of several special features such as design for a sub-tropical climate, operation by native staff. Reference is made to the erection work and to the preparations which had to be made.

621.311.21  
DEVELOPMENT OF POWER STATIONS IN THE UPPER NAMSEN. A.Haaland.  
Tekn. T., Vol. 90, No. 19, 513-17 (May 6, 1960). In Norwegian.

The utilization of the water power of the upper Namsen in the northern Norwegian-Swedish frontier region requires the close collaboration of the supply authorities of both countries. The main problem was to regulate the outflow from and inflow to the Limingen lake so as not to deprive the Norwegian-Swedish station at Limingen and lower-lying stations of their water. The power expected to be generated in joint operation of the scheme - divided roughly equally between both countries - is 200 GWh/yr. The most important civil engineering work is described; this included construction of a 3250 m, 45 m<sup>2</sup> inflow tunnel and stations at Tunnsjo and Tunnsjodel of powers and heads of 116 and 725 GWh/yr and 54 and 230 m respectively. G.N.J.Beck

621.311.21  
5319 THE ECONOMICS AND DESIGN OF THE BLAENAU FFESTINIOG PUMPED STORAGE SCHEME.  
E.S.Booth and G.Kennedy.

World Power Conf., Canadian Sectional Meeting (Montreal, 1958), Section A<sub>2</sub>/4, Paper 68 A<sub>2</sub>/4.

Work on the site of the Ffestiniog scheme was started in April, 1957, and the station is scheduled for operation in two equal stages, one in 1961 and the other in 1962. Pumping will be restricted to the hours between midnight and 6.30 a.m., and generation to between 4 and 4½ hr per day to cover the main peak periods. The maximum generating capacity will be 300 MW, obtained from four 75 MW machines, the daily output being  $1.2 \times 10^6$  kWh. The "economic" annual load factor will be about 3.5%. Tables of cost data and economic assessment are given, as well as diagrams of the site and of the layout of the scheme. E.W.Golding

621.311.21 : 621.316.728  
AUTOMATIC REGULATION OF HYDRAULIC POWER STATIONS. See Abstr. 4751

621.311.22  
5320 MODERNIZATION OF MEDIUM-PRESSURE THERMAL POWER STATIONS. V.G.Zhilin.  
Elekt. Stantsii, 1959, No. 10, 2-10 (Oct.). In Russian.

Some of the problems involved are discussed under the headings: improvement schemes, superimposed turbines, appraisal of effectiveness of modernization, meeting load demands, fuel saving, operating expenses, capital investment and general efficiency resulting from modernization.

Central Electricity Generating Board Digest

621.311.22  
5321 SOME PROBLEMS IN THE STARTING-UP OF THERMAL POWER STATIONS. S.L.Mirenburg.  
Elekt. Stantsii, 1959, No. 11, 28-33 (Nov.). In Russian.

Examines the problem of power supply and heat supply during the commissioning of newly constructed thermal power stations. Power can be supplied by local power systems, a power train, gas turbines, etc. An analysis is given of the power requirements of all the equipment in the power station during the starting-up period. Heat is generally provided during this period by temporary mobile low-pressure boiler plants. A description is given of one type of heat-supply system. Metropolitan-Vickers

621.311.22  
5322 COAL FIRING INSTALLATIONS IN STEAM POWER STATIONS — A DESCRIPTION OF THE ELECTRICAL EQUIPMENT IN THE STEAM POWER STATION OF THE BAYERISCHER A.G. (BAVARIAN NATIONAL ELECTRICITY UNDERTAKING) AT SCHWANDORF. W.Fraass.  
Elektrizitätswirtschaft, Vol. 59, No. 6, 148-52 (March 20, 1960). In German.

The coal handling plant of the Schwandorf Power Station is described in detail. An increase of 100 MW of installed capacity after 1958, and the expectation of further increases in demand, made the installation of a completely new coal handling plant essential. Electrical methods have been used to provide a simple, yet flexible, supervisory and control system. Full use has been made of illuminated symbolic displays to indicate the state of the plant. Operation of the coal-firing installation is complex, but optimum safety conditions have been achieved. In describing the new plant, the article indicates how the various safety devices have been installed and

function in comparison with the methods used earlier. It is also shown how some of these devices may be used to solve similar types of operational problem.  
E.W.Golding

621.311.22

# THE KLÖCKNER POWER STATION AT CASTROP-RAUXEL. A.von Brackel and H.Emonts.

Siemens-Z., Vol. 33, No. 9, 542-56 (Sept., 1959). In German.

The new power station of Klöcknerwerke AG supplies power both to the works-owned collieries and to the public supply system. The boiler plant, turbo-generating unit and the feed-heating plant form a single block. The boiler plant consists of two half-load Benson boilers. The turbine is designed for an inlet pressure of 180 kg/cm<sup>2</sup> gauge (2560 p.s.i.g.) and a live steam and reheat temperature of 520° C. The maximum continuous output is 120 MW. A description is given of the construction and equipment of the power station.

621.311.23

# SOME FEATURES OF THE PORT MANN GAS TURBINE GENERATING STATION. T.Inglewood.

Engng J., Vol. 43, No. 5, 64-8 (May, 1960).

Intended to provide firm and peak power for British Columbia's 778 MW hydro system, this station on the Fraser River consists of four 2-stage reheat open-cycle gas turbine sets each rated 25 MW at 25° F and 21.6 MW at 70° F. Natural gas or crude oil are used as fuel. The 13.8 kV 3600 rev/min alternators are connected to the busbars through 1500 MVA air-blast circuit-breakers; transmission is over an existing 230 kV line through two 50 MVA transformers. The plant is unattended and controlled from Vancouver head office through a 12 mile microwave link.  
P.Linton

621.311.25

# THE DEVELOPMENT OF ATOMIC ENERGY IN THE SOVIET UNION. N.A.Nikolaev.

J. nuclear Energy, Vol. 7, No. 1-2, 103-8 (Aug., 1958). English translation from: Atomnaya Energiya, Vol. 3, No. 11, 385 (1957).

In the current 5 year period 3 types of nuclear reactors will be built in atomic power stations in Russia. These are (a) graphite-moderated, pressurized-water and steam-cooled (see following abstract); (b) pressurized-water moderated and cooled; and (c) D<sub>2</sub>O moderated CO<sub>2</sub> cooled. A brief description of each reactor type and estimated costs are given. Four smaller experimental reactors to be built are: (a) a boiling light-water reactor (b) a sodium graphite reactor (c) a boiling-water reactor with a suspension of solution of U<sup>235</sup> as fuel and (d) a fast reactor.  
R.D.Smith

621.311.25

# THE URANIUM-GRAPHITE REACTOR AND SUPER-HEATED STEAM POWER STATIONS. N.A.Dollezhal.

J. nuclear Energy, Vol. 7, No. 1-2, 109-14 (May, 1958). English translation from: Atomnaya Energiya, Vol. 3, No. 11, 391 (1957).

A figure of merit for a nuclear power station is derived in terms of the capital and fuel costs, processing costs, nuclear performance etc. and its application to different types of reactor illustrated. A 285 MW (thermal) graphite-moderated, light-water and steam-cooled power reactor is described in outline. The reactor produces 405 tonnes/hr of steam at 500° C and 90 atm.

R.D.Smith

621.311.25

# THE EFFICIENCY OF ATOMIC POWER STATIONS. (A REVIEW). I.I.Novikov.

J. nuclear Energy, Vol. 7, No. 1-2, 125-8 (Aug., 1958). English translation from: Atomnaya Energiya, Vol. 3, No. 11, 409 (1957).

An expression for the efficiency of atomic power stations is derived in terms of the temperature in various parts of the cycle. An approximate expression giving the coolant temperatures for maximum power output is derived.  
R.D.Smith

621.311.25

# CRITERIA FOR THE SELECTION OF THE SITE FOR NUCLEAR POWER STATIONS. T.Leardini.

Tecn. Ital., Vol. 25, No. 3, 199-203 (April-May, 1960). In Italian.

The following points are dealt with: inherent safety of the reactor; control, scram, and safety devices; disposal and treatment of effluents; maximum possible accident; evaluation of dangers deriving from this accident; meteorological and radio activity surveys of the site selected; and criteria adopted for the safety assessment.

621.311.25

# HEAVY-WATER MODERATED POWER REACTORS - PROPOSAL FOR AN IMPROVED DESIGN.

5329

B.Hargb, A.Dahlgren and G.Andersson.

Tekn. T., Vol. 90, No. 24, 645-57 (June 10, 1960). In Swedish.

A completely homogeneous heavy-water reactor is under development in Sweden. A 100 MW electrical output is envisaged, to be increased later possibly to 250 MW. Two arrangements for placing the fuel in the reactor in good contact with the whole moderator volume are considered. The reactor will combine many of the advantages of the light-water reactor and the conventional heavy-water reactor. A high output without thermally or mechanically stressing the system is promised; there is a possibility of using natural uranium, and maintenance is simplified, inherent safety is high and neutron economy good.  
G.N.J.Beck

621.311.26

# THE "GROTE HEIDE" PUMPING STATION OF THE VENLO MUNICIPALITY. A.M.H.Stroucken.

5330

Electrotechniek, Vol. 38, No. 1, 203-7 (March 30, 1960). In Dutch.

The pumping station contains 11 wells of 100 m depth. Under-water pumps at a depth of 22 m have a power of 10 h.p. and pump at 45 m<sup>3</sup>/hr. The electrical supply, described in detail, is obtained at 10 kV from the public system or from a reserve Diesel-generator set. Special interlocking equipment prevents paralleling of the latter with the mains supply. Two totally enclosed 10000/380 V, 200 kVA transformers are installed. All the motors are directly switched, without controllers. The reserve supply comprises a 208 h.p. Diesel engine with a 3-ph. compound generator with 70 KVA output at 400 V.  
G.N.J.Beck

621.311.26 : 621.313.32

# ANALYSIS OF LOAD TRANSFER OSCILLATIONS IN PARALLEL AIRCRAFT A.C. ELECTRIC POWER SYSTEMS. H.A.Kahle.

5331

Trans Amer. Inst. Elect. Engrs II, Vol. 79, 22-6 (1960) = Applic. and Industr., No. 47 (March, 1960).

This paper utilizes the work of two previous papers, Abstr. 1137 of 1957, and "Analogue computer representations of aircraft parallel a.c. Generating Systems", Boffi, Riaz and Smith, Wright Air Development Center Technical Note 56-384, and sets out to extend this to examine hunting in parallel generator systems by simulation techniques. The electrical and mechanical characteristics of the two systems are assumed to be identical, each comprising a generator, regulator, constant-speed drive, and active and reactive load sharing circuits. As the oscillations are symmetrical with respect to the bus-bars, it is claimed that only one generating system need be considered. This reduces considerably the complexity of the problem and the amount of simulation equipment required. From the analysis given, block diagrams representing a parallel generator system and its components are derived. The operation of the system is then discussed on the basis of this simulation. A bibliography is included.  
J.T.Hayden

621.311.4

# APPLICATION OF SIMATIC COMPONENTS FOR THE LOCAL-REMOTE CONTROL OF LARGE SWITCHING STATIONS. R.Hahn.

5332

Siemens-Z., Vol. 33, No. 10, 619-21 (Oct., 1959). In German.

SIMATIC components make it possible to construct the local-remote control systems for large switching stations in a completely new manner. These components have been used to develop the mimic-diagram control system which incorporates the most recent improvements in digital control and meets operational requirements more fully than hitherto. Since it is constructed on the unit construction principle, mimic-diagram control can easily be adapted to the size and circuit arrangement of every station.

621.311.42

# TRANSFORMER SUBSTATIONS IN RURAL SUPPLY (IN SWEDEN). L.Iveberg and S.Edenius.

5333

E.R.A. (Stockholm), Vol. 33, No. 4, 49-52 (1960). In Swedish.

Older standardized designs of tertiary distribution substations for 40, 20/6 or 10 kV have been modernized. Two designs (K1 and K2) 10 kV totally enclosed aluminium-clad and thermally insulated switching stations are described. These can be assembled from prefabricated units. The K2 design contains circuit-breakers, isolators, instrument transformer, and distribution busbar of 120 in<sup>2</sup> 10 kV plastic cable for continuous 400 A load.  
G.N.J.Beck

- 621.311.6  
 5334 AN AUTOMATIC DEVICE FOR LOAD DISTRIBUTION IN POWER SYSTEMS.  
 S.V. Usov, G.M. Pavlov, V.A. Slabikov and I.A. Budkin.  
 Elektrichestvo, 1960, No. 4, 47-51 (April). In Russian.

## ELECTRIC MACHINES

- 621.313.047.4  
 5335 A RELIABLE TECHNIQUE FOR MEASURING BRUSH WEAR IN AN ATMOSPHERE CONTAINING SILICONE VAPOR. J.S. Axelson and F.M. Precopio.  
 A.S.T.M. Bull., No. 244, 40-2 (Feb., 1960).  
 Tests were made on five different types of brush submitted by manufacturers as suitable for use in silicone atmospheres. A standard grade of brush, not claimed to be resistant to wear in such atmospheres, was used as a control. The sealed test chamber housed ten sliprings with associated brushgear and contained a removable tray which could be filled with a silicone fluid of known vapour pressure to provide a controlled silicone atmosphere. All brushes were first tested in a silicone-free atmosphere and then in a silicone atmosphere. The wear data was analysed statistically, and graphs of brush wear against time were plotted for each of the five test grades. Wear resistance in a silicone atmosphere varied considerably and three of the brush types tested showed no significant improvement over the control brush. All brushes showed a higher wear rate in the silicone atmosphere than that of the control brush in a normal atmosphere. There is a short bibliography. T.J. Anderson

- 621.313.1  
 5336 EXPLORING PARALLEL PLANE FIELDS WITH THE HELP OF ANALOGOUS ELECTRICAL CURRENT FIELDS.  
 E. Schlitz.  
 Arch. tech. Messen, No. 289, (V312-5), 25-6 (Feb., 1960). In German.  
 Describes techniques using aluminium foil to simulate magnetic field structures in sections of electrical machines. The relationships between the magnetic and electrical analogy are developed. K.C. Garner

- 621.313.1  
 5337 CLASSIFICATION OF THE DIFFERENTIAL EQUATIONS OF GOREV AND PARK. L.P. Veretennikov.  
 Elektrichestvo, 1959, No. 11, 13-20 (Nov.). In Russian.  
 A previous paper (Abstr. of 1960) dealt with the question of the various forms of presentation of the Gorev-Park equations. This paper is an extension of the system of equations and a rationalization for various conditions of the rotor-stator excitation characteristics and equations of moments for synchronous machines. J.S. Wilson

- 621.313.1  
 5338 LIFE EXPECTANCY OF ELECTRICAL MACHINES WITH VARIABLE LOADS. J. Ben Uri.  
 Proc. Instn Elect. Engrs, Monogr. 354 U, publ. Feb., 1960 (Vol. 107 C, 137-44, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 2006 of 1960.

- 621.313.1  
 5339 AN IMPROVED METHOD OF CORONA SUPPRESSION FOR HIGH-VOLTAGE ROTATING MACHINES.  
 V.E. Manni and W. Schneider.  
 Trans Amer. Inst. Elect. Engrs III, Vol. 79, 49-52 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).  
 Recognizing that the appearance of corona in areas of high voltage stress is evidence of chemical attack on the insulation, a method of eliminating the phenomenon has been evolved which is applicable to the vulnerable zone at the stator coil ends. This supplements the existing conducting varnish film with overlapping sleeves of foil of accurately graduated length wound round the conductors. The effect of this is to provide a number of voltage steps between the conductor and the core. The method of calculating the number and length of the overlapping sleeves is described and test results are set out. D.R. Way

- 621.313.1.017.31  
 5340 EQUIVALENT CIRCUIT AND EVALUATION OF EDDY-CURRENT LOSS IN SOLID CORES SUBJECTED TO ALTERNATING AND ROTATING MAGNETIC FIELDS.  
 N. Kesavamurthy and P.K. Rajagopalan.  
 Proc. Instn Elect. Engrs Monogr. 365 U, publ. June, 1960 (Vol. 107 C, 353-65, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 4647 of 1960.

- 621.313.12 : 621.318.435.3  
 APPLICATION OF TRANSDUCTORS TO THE VOLTAGE REGULATION OF EXCITERLESS GENERATOR. See Abstr. 4865

- 621.313.126  
 5341 ELECTRONIC EXCITATION FOR MACHINES IN THE MAIN DRIVE OF REVERSING ROLLING MILLS.  
 M. Ya. Pistrak and L.M. Balabusov.  
 Elektrichestvo, 1960, No. 4, 13-20 (April). In Russian.  
 A description is given of a system using mercury-arc converter sets for the excitation of generators and motors for the main drives of rolling mills, with details of the method of operation. Industrial operation of this system has shown its advantages over rotary-amplifier control systems. The control time is reduced and the current regulators made more effective as a result of the low inertia of the control elements.

Associated Electrical Industries (Manchester)

- 621.313.13  
 5342 THE APPLICATION OF MINIATURE MOTORS IN PRECISION ENGINEERING. F. Dohrmann.  
 Siemens-Z., Vol. 34, No. 4, 273-7 (April, 1960). In German.  
 In precision engineering, many types of miniature motors are called for. A description is given of the construction and mode of operation of synchronous, induction and variable-speed motors with output ratings up to about 5 W. Several examples are given of their application and the most important data are compiled in tables. The performance of the variable-speed motors is shown by characteristic curves.

- 621.313.13 : 621.34  
 WINDING MACHINES FOR THE MECHANIZED AND AUTOMATIC PRODUCTION OF SMALL MOTORS. See Abstr. 4774

- 621.313.14  
 5343 A UNIVERSAL MOTOR SUPPLIED THROUGH THYRATRONS. J. Coulon, J. Meric and M. Serayssol.  
 C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3813-15 (June 8, 1960). In French.  
 The rotor consists of 4 soft-iron bars mounted on a non-magnetic cylinder. The stator has 6 yokes relatively displaced by 60°. The coils on the yokes are excited through thyratrons, by means of a distributor coupled to the rotor. The theory is explained briefly and it is shown that the torque is constant at any speed. Supplied with a.c. at 50 c/s, the max. speed is 750 rev./min. and the motor acts as a squirrel-cage motor. For d.c., the speed is limited by the ionization time of the thyatron and may reach 1400 rev./min. R.G. Jakeman

- 621.313.2 : 621.317.38  
 OSCILLOGRAPHY OF THE ELECTROMAGNETIC TORQUE OF A D.C. MOTOR USING HALL-EFFECT PROBES. See Abstr. 4805

- 621.313.2.047.2 : 621.317.312  
 5344 A NEW METHOD FOR OBSERVING THE PHENOMENA OF COMMUTATION.  
 H.J.H. Sketch, P.A. Shaw and R.J.K. Splatt.  
 Proc. Instn Elect. Engrs, Paper 2955 M, June, 1959 (Vol. 107 A, 336-9, 339-42, Aug., 1960).  
 Republication with discussion, of the paper already abstracted as Abstr. 3925 of 1959.

- 621.313.3  
 5345 DETERMINATION OF TRANSIENTS IN A.C. MACHINES BY MEANS OF THE FREQUENCY CHARACTERISTICS.  
 E. Ya. Kasovskii.  
 Elektrichestvo, 1960, No. 4, 30-7 (April). In Russian.  
 Describes the use of the frequency characteristics of a.c. machines for calculating transient phenomena. The calculations relate only to conditions of constant speed and do not allow for



saturation of the machine. Details are given of the fundamental mathematical relations forming the basis of the frequency methods, new methods of determining the frequency characteristics from transient phenomena, and a method of calculating the transient occurring when the machine is connected to the network and during three-phase short-circuits.

Associated Electrical Industries (Manchester)

621.313.3

5346 ON THE EFFECTS OF EDDY-CURRENTS IN THE SOLID ROTOR OF A POLYPHASE MACHINE BY FREQUENCY-RESPONSE METHOD. I. P. Mukherjee and S.K. Sen. J. Technol. (Calcutta), Vol. 4, No. 1, 47-62 (June, 1959).

Electrical machines having solid magnetic circuits may be analysed by this method as the circuit parameters depend on the frequency due to induced eddy-currents. The problem of eddy-current effects in the solid rotor of a high turbo-alternator is investigated by dividing it in three parts: (i) effects in the solid rotor having no slots and no winding; (ii) effects in the rotor with slots only in the quadrature-axis; (iii) effects in the rotor with slots and winding. In this paper, item (i) is discussed. Items (ii) and (iii) will be presented subsequently. With a sinusoidally magnetic field pulsating in the air-gap, the driving point impedance and admittance loci are evaluated using Maxwell's equations in a conducting homogeneous, isotropic medium. The loci are then related to the parameters of the magnetic circuit of a synchronous machine.

621.313.32 : 621.311.28

ANALYSIS OF LOAD TRANSFER OSCILLATIONS IN PARALLEL AIRCRAFT A.C. ELECTRIC POWER SYSTEMS. See Abstr. 5331

621.313.322

5347 ROTOR BINDINGS OF ALUMINIUM ALLOYS. N.M. Rabinovich. Elekt. Stantsii, 1959, No. 7, 49-52 (July). In Russian.

The most stressed part in modern turbo-generators is the steel binding ring of the rotor. About 50% of the total stress on this ring is caused by the centrifugal forces of its own weight. It is suggested that lighter materials should be used, in particular aluminium alloys. A set of experimental rings was produced for installation on a 6 MW turbo-generator and tests carried out. Details are given of the composition and properties of the metal used, and of the design of the rings.

Metropolitan-Vickers

621.313.322

5348 SELECTING THE BASIC PARAMETERS OF EXCITATION SYSTEMS FOR SELF-EXCITED SYNCHRONOUS GENERATORS. D.V. Vilesov and I.A. Ryabinin. Elektrichestvo, 1960, No. 3, 20-4 (March). In Russian.

It is shown how to determine the basic parameters of excitation system by a method using the characteristics of the generator as a basis. Only one system of the many possible variants is considered: phase-compounding with summation of the currents proportional to the voltage and current of the main circuit of the generator. It is claimed, however, that the results can be applied to any other version of the excitation system.

Associated Electrical Industries (Manchester)

621.313.322

5349 SELECTION OF THE DIFFERENTIAL EQUATIONS FOR THE TRANSIENTS IN STUDIES OF THE DYNAMIC STABILITY OF SYNCHRONOUS GENERATORS USING COMPUTERS. B.M. Kagan and E.L. Urman. Elektrichestvo, 1960, No. 4, 37-42 (April). In Russian.

The theoretical value of the dynamic stability limit can be affected by various factors, including saturation, the damping system, and transformer e.m.f.'s induced in the stator winding, and the authors seek to evaluate these effects. In this way the most important factors for individual investigations can be found and those of lesser importance ignored.

Associated Electrical Industries (Manchester)

621.313.322 : 621.317.333

5350 ELECTRICAL TESTING OF THE INSULATION OF LARGE GENERATORS. H. Gosdam. Elin J., 56-62 (Sept., 1959).

After a discussion of the modern construction of bar insulation, the routine tests during manufacture are described. These include: (a) loss-angle; (b) a.c. and d.c. overpotential tests; (c) d.c. and a.c. puncture voltage; (d) long-duration tests; and (e) localizing of glow spots and measuring the glow-point. Dielectric tests on installed machines are also described.

R.G. Jakeman

621.313.322  
5351 SPECIAL CASES OF THE SHORT CIRCUIT WITH SYNCHRONOUS MACHINES. W. Schuisly. Ingenieur, Vol. 72, No. 23, E31-E34 (June 3, 1960). In Dutch.

To stabilize operation when load surges or short circuits occur, surge excitation is now commonly used. An increased exciter voltage is applied immediately the disturbance occurs. The synchronizing torque is thereby increased and voltage drops are compensated. For these special conditions, using general equations for rotating-field polyphase machines, the currents of synchronous machines are calculated for two cases: short circuits with full voltage and load; short circuits with full voltage and rapid response. The second case also covers the performance of the short-circuit test generator. See also Abstr. 5696 of 1959.

G.N.J. Beck

621.313.332 : 621.318.435.3

TRANSDUCTOR VOLTAGE REGULATOR FOR MEDIUM-FREQUENCY GENERATORS. See Abstr. 4867

621.313.322 : 621.318.435.3

THREE-PHASE TRANSDUCTORS FOR THE ADDITIONAL VOLTAGE REGULATION OF COMPOUNDED SYNCHRONOUS GENERATORS. See Abstr. 4866

621.313.322 : 621.316.728

MEANING AND DEFINITION OF RESPONSE SPEED OF EXCITATION OF EXCITER SYSTEMS. See Abstr. 4749

621.313.322-713

5352 A TURBOGENERATOR STATOR WITH A WINDING WITH DIRECT WATER-COOLING.

Z.B. Kogan and V.V. Titov.

Elekt. Stantsii, 1959, No. 7, 45-9 (July). In Russian.

The test results with this design, in which the rotor was hydrogen-cooled and the stator-winding water-cooled, showed that with a simultaneous increase of the gas pressure to 1-2 atm the output could be increased by 100% and more, without a higher temperature rise.

Electrical Research Association

621.313.322-8 : 621.311.21

5353 GENERATORS FOR THE SVÆLGFOSS III HYDRO-ELECTRIC POWER STATION IN NORWAY.

L. Nasahl and E. Ulbrich.

Siemens-Z., Vol. 33, No. 11, 703-9 (Nov., 1959). In German.

A description is given of the design of two three-phase umbrella-type synchronous generators each with a rating of 55 MVA, 10.5 kV at 187.5 r.p.m. Interesting features are the relatively low height of the generators and the lowering device for the thrust bearing arranged underneath the rotor. The generator losses are determined by the calorimetric method. This method and also the arrangement employed are described briefly.

621.313.322-81

5354 DEVELOPMENT TRENDS IN THE CONSTRUCTION OF TURBO-ALTERNATORS. F. Müller.

B.B.C. Nachr., Vol. 42, No. 6-7 279-86 (June-July, 1960). In German.

After tracing the history of turbo-alternator development, present-day Brown Boveri practice for machines up to 500 MVA is described. Output limits for various types of cooling are given. Some constructional features, including direct-cooled rotor and stator windings, cooling circuits, rotor construction, end-bell design and damper winding are briefly discussed and illustrated with the help of photographs and sketches.

H. Sterling

621.313.322-81

5355 JOINT RUN-DOWN OF A TURBO-GENERATOR AND HOUSE AUXILIARIES.

O.V. Livanova, M.L. Fel'dman and A.P. Chistikov.

Elekt. Stantsii, 1959, No. 10, 47-53 (Oct.). In Russian.

Determines experimentally the duration of the joint run-down of a turbo-generator and pumps driven by synchronous motors, and compares experimental data with the results of calculations. Experiments were carried out using motors with and without salient poles. It is shown that the run-down time for a 30 MW turbo-generator and two salient-pole motors each of 1.6 MW amounts to some 110 sec.

Metropolitan-Vickers

621.313.322-81

5356 RESYNCHRONIZATION OF SYNCHRONOUS GENERATORS. M.G. Portnoi.

Elektrichestvo, 1960, No. 1, 73-8 (Jan.). In Russian.

A study of a method of determining the conditions for restoring



synchronism and the duration of asynchronous operation shows that after dynamic-stability breakdown or non-synchronous connection, the pulling-into-step of generators often takes place without the intervention of attendance personnel. Greatest effect on this resynchronization process is exerted by the turbine torques, varying under the influence of speed regulators, and the asynchronous and natural torques caused by the load and active losses in the lines. Resynchronization conditions can be worked out by the method described both for one generator in an infinitely large power system and for two generators having commensurate capacity.

Central Electricity Generating Board Digest

621.313.322-82

#### DRYING WETTED STATOR WINDINGS OF LARGE

5357 WATER-WHEEL GENERATORS AFTER INSTALLATION. G.G. Birshter and I.K. Sevryugin.

Elekt. Stantsii, 1959, No. 6, 38-41 (June). In Russian.

At contemporary speeds of erection of generators in power stations, the installation of equipment may precede the construction of the machine room. Work is carried on under temporary covers and, as a result, the insulation of the generators may be subject to considerable dampness. A drying method used for three generators at the Volga hydro-electric station is described. Recommendations are made regarding the most suitable temperature increase for drying, and the appropriate temperature drop between the copper and the cooling air.

Metropolitan-Vickers

621.313.322-82

#### WATER-WHEEL GENERATORS FOR POWER STATIONS WITHOUT MACHINE ROOMS. L.Ya. Stanislavskii.

Elekt. Stantsii, 1959, No. 8, 23-9 (Aug.). In Russian.

The construction of power stations without machine rooms for the hydro-electric generators means a considerable saving in construction costs. Stations of this type in Czechoslovakia, Switzerland, U.S.A. and U.S.S.R. are described. It is shown that the Russian generators designed for use in such power stations can be maintained and overhauled without removing the protective domes and thus are suitable for use in any climatic conditions. By combining the protective dome and the top spider of the generator it is possible to reduce the weight and the cost of the machines. Wider use of such stations is recommended.

Metropolitan-Vickers

621.313.33.1

#### NATURE OF THE TORQUE-SPEED CHARACTERISTIC AND THE MAGNETIC NOISE OF SQUIRREL CAGE

5359 MOTORS. T. Torda.

J. Instn Engrs Australia, Vol. 31, No. 7-8, 191-3 (July-Aug., 1959).

The general purpose motor with squirrel cage rotor has to comply with the requirements of specified starting and pull-out torques, a smooth torque-speed characteristic and a low sound level during starting as well as during working periods. There is a simple method of determination of rotor slot numbers which, in relation to the slot number and to the coil-pitch of the stator winding, produce good or bad torque-speed curves and low or high magnetic noise. The complete range of these rotor slot numbers, which includes the permissible maximum and the practicable minimum rotor slot numbers, corresponds to a stator winding with a coil-pitch equal to the pole-pitch. This paper deals with this special case and divides the rotor slot numbers into several grades of slot combinations. The agreement between the grades of the slot combinations and test data is shown in several practical examples, confirming the well-known experience, that the most frequent and dangerous source of dips in the torque-speed curve and of troublesome magnetic noise is the interaction of flux waves of the first slot harmonic orders in the stator and rotor.

621.313.333 : 621-526

#### THE TWO-PHASE INDUCTION MOTOR USED AS A SERVO MOTOR. D. Connelly.

Proc. Instn Elect. Engrs, Paper 3280M, publ. Aug., 1960 (Vol. 107A 366-82).

The performance of a 2-phase induction motor used as a servo motor depends upon the alteration of the machine from 2-phase to single-phase operation. This can be effected in three ways. Two depend upon change of applied voltage and the third depends upon alteration of the relative disposition of two stators in a specially constructed machine. The speed/torque relationship for the three conditions is deduced from the initial assumption that the flux-density is sinusoidal in space and time. The analysis reveals that single-phase motors have a maximum speed dependent upon the

rotor resistance/reactance ratio as well as the frequency. It suggests a more appropriate definition of synchronous speed than that commonly accepted, namely as that speed at which the unidirectional torque becomes zero. Theoretical performance curves of the machine as a 2-phase motor, as a single-phase motor and in the intermediate condition between these two extremes are given, for various assumed resistance/reactance ratios, as a function of the parameter which alters the machine from 2-phase to single-phase operation. Comparison between theoretical and experimental curves is made. The resistance/reactance ratio of the 2-phase servo motor, required for effective speed control near zero speed, is demonstrated by the curves.

621.313.333 : 621.142

#### THE CALCULATION OF SHADED POLE MOTOR PERFORMANCE BY THE USE OF A DIGITAL COMPUTER.

G.H. Sherer and G.E. Herzog.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1607-10 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The results of solving Chang's equivalent circuit (Abstr. 568 of 1952) by the use of a digital computer are reported as follows.

- (1) Maximum efficiency is obtained with the smallest shading angle.
- (2) Increasing the shading angle increases the ratio of locked torque to maximum torque up to  $60^\circ$ .
- (3) Several critical shading coil locations show a large asynchronous cusp which can be reduced by increasing the shading angle above  $60^\circ$  at the cost of reduced efficiency.
- (4) Efficiency increases but horsepower output and torque are reduced as shading coil resistance increases.
- (5) The ratio of locked torque to maximum torque increases as the shading coil resistance decreases.
- (6) As pole tip leakage increases, efficiency, output power and torque and the ratio of locked torque to maximum torque decrease.

G.A. Montgomerie

621.313.333

#### THE THEORY AND DESIGN OF A VERY-SLOW-SPEED RELUCTANCE MOTOR. C.H. Lee.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1683-8 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The particular motor discussed is a 3 ph. 4-pole salient-pole type having a rated speed of 8 rev/min when supplied with 200 V peak at a frequency of 0.267 c/s. The pull-out torque is 10 lb ft, input power 490 W and a peak line current of 2.8 A. The inside of the motor is filled with water at a temperature of  $350^\circ\text{F}$  at 2000 lb/in<sup>2</sup>. Design and constructional features are described and a numerical example is included.

G.V. Hargreaves

621.313.333 : 621.34

#### THE APPLICATION OF LINEAR INDUCTION MOTORS TO CONVEYORS. See Abstr. 4773

621.313.334

#### STABILITY OF A REGULATOR CONTROLLING THE EXCITATION OF A SMALL SYNCHRONOUS MOTOR.

D.P. Petelin.

Elektrichestvo, 1960, No. 2, 25-7 (Feb.). In Russian.

The scheme described uses an amplifier of the amplidyne type. Details of the various equations for the synchronous motor under steady-state and transient conditions are given and stability requirements are derived. In order to obtain stability a feedback link of the type  $\tau_p/(1 + \tau_p)$  is used. Oscillograms of stator current, excitation current, output and internal displacement angle show the effect of the feedback on a 3.6 kVA motor.

J.S. Wilson

621.313.362

#### THE EFFECT OF THE NUMBER OF SECONDARY PHASES ON THE DIMENSIONING OF A THREE-PHASE SHUNT COMMUTATOR MOTOR. R. Schmitz.

Elektrie, Vol. 13, No. 11, 434-6 (Nov., 1959). In German.

An extension to a previous article (Abstr. 3513 of 1954). It is shown that an increase in the number of secondary phases and the addition of damping windings has in general no effect on the size of the commutator and very little on the dimensions of the core. A correction is made to the previous article with regard to the commutating voltages of the 6- and 3-brush arrangements. The values are the same in both cases and not as stated.

R.G. Jakeman

## TRANSFORMERS

- 621.314.2  
 5365 RESEARCH AND DEVELOPMENT IN TRANSFORMER CONSTRUCTION. K.Schlosser.

B.B.C. Nachr., Vol. 42, No. 6-7, 287-97 (June-July, 1960). In German.

In recent years much study has been directed to the design of transformers for very high voltages and of high outputs but suitable for rail transport. The knowledge gained can, however, also be applied with advantage to other transformers. From this aspect the following are reviewed: use of grain-oriented sheet, oils and insulating materials, impulse strength, cooling, short-circuit forces, noise, tap-changing and bushings. Brief reference is made to the use of digital computers in transformer design. A.P.Wilmshurst

- 621.314.2  
 5366 INFLUENCE OF THE HEIGHT UPON THE LOCAL AND MEAN THERMAL CAPACITY OF THE WINDING SURFACE OF AIR-COOLED TRANSFORMERS BASED UPON MODEL TESTS. T.Boduroglu.  
 Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 12, 277-87 (June 15, 1960). In German.

Although empirical mean heat dissipation constants are used for the thermal design of transformer windings, it is considered worth while to study the problem in greater detail in order to provide design data for further development work. A model consisting of a number of test rings stacked to form a cylinder was used to examine the influence of the height of individual coils upon their thermal characteristics. Precautions were taken to ensure that heat was dissipated from the external vertical surface of the cylinder only. Each ring could be heated independently and the temperature of all rings was kept the same so that radiation losses would be independent of height. A definite relationship between heat flow through convection and height was observed when the air flow was laminar. With the onset of turbulence, however, which depends upon height as well as temperature, convectional thermal flow increases irregularly. Test results obtained under various conditions are tabulated. A.S.Hay

- 621.314.2  
 5367 DRYING SHELL-TYPE POWER TRANSFORMERS WITH ZERO-SEQUENCE CURRENTS. A.I.Kurinenko.  
 Elekt. Stantail, 1959, No. 8, 36-7 (Aug.). In Russian.

The usual method for drying transformers after overhaul, installation, etc. (in their own tank, without oil, with vacuum) requires considerable preparation and expenditure on materials. The use of a simpler method for single-phase shell-type transformers using zero-sequence currents is suggested. This method has previously only been used for three-phase transformers. Actual examples of the application of this method are described. It is shown that this system can be applied for transformers up to 20 MVA using standard voltages of 220-380 V. Metropolitan-Vickers

- 621.314.2  
 5368 DETERMINATION OF THE OPTIMUM DIMENSIONS OF A TRANSFORMER. P.Kyul'ovskii and Kh.Kukushev.  
 Elektrichestvo, 1960, No. 3, 43-8 (March). In Russian.

Presents a more convenient method for calculating the optimum dimensions of a transformer, making it easier to obtain a given no-load current. The method is explained in detail and a numerical example appended.

Associated Electrical Industries (Manchester)

- 621.314.2  
 5369 GAS-INSULATED POWER TRANSFORMERS. G.Camilli.  
 Proc. Instn Elect. Engrs, Paper 3288S, publ. Aug., 1960 (Vol. 107A, 375-82).

Power transformers have reached such a degree of perfection that it seems unlikely that there is room for substantial improvement in any fundamental characteristic. However, the insulation of conventional transformers is in the main dependent upon a liquid which is not only inflammable but has other undesirable characteristics. The substitution of gas for oil as the insulating medium eliminates the undesirable characteristics of the latter, and in addition, gas-insulated units have other advantages. Of the various gases having desirable properties for use in modern equipment, sulphur hexafluoride is prominent. It is produced commercially in

the United States. After reviewing the advantages of gas-insulated transformers, the paper examines the fundamental characteristics of this electro-negative gas, and experimental data are presented of its electric strength relative to oil. Of considerable interest to the designer is the peculiar behaviour of gases subjected to impulse tests. It is shown that, for the same low-frequency electric strength, gas-insulated units have lower impulse strength than oil-filled transformers. This deficiency, however, can be overcome with liberal margins of safety if gas-insulated transformers are protected with modern lightning arresters. The cooling of these new transformers is by forced circulation of the gas. The thermal capacity of gas-insulated units is, of course, somewhat lower than that of oil-filled units; theoretically, it would appear that, on this account, the overload capabilities of gas-filled transformers might be much lower than those of oil-filled units. This apparent deficiency is partially nullified by the fact that the thermal ageing characteristics of conventional class-A materials used in the construction of transformers is higher in gas than in oil. Consequently, the overload capabilities of gas-insulated units compare quite favourably with those of oil-filled units cooled by force circulation of the liquid. Two units rated at 2000 kVA are in service in New York City; a third unit rated at 10 000 kVA is in operation at Allentown, Pennsylvania. This unit is briefly described. Several other units, some of higher apparent power and voltage are now under construction. Development is proceeding, and it appears that in the near future some very large transformers may be built which could be installed next to, or built as an integral part of, the generators, and this at considerable overall cost reduction over present practices.

- 621.314.2  
 5370 TANK PRESSURES RESULTING FROM INTERNAL EXPLOSIONS. R.J.Ringlee and N.W.Roberts.  
 Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1705-10 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Tests are reported on a full-size oil-filled rectangular tank transformer to establish transient pressure conditions following an internal fault, as affected by magnitude and location of fault, and of gas space in the tank. The pressure rise was produced by a "fault simulator" which released a metered quantity of compressed nitrogen within a mean time of 67 milliseconds (i.e. about 4 cycles) at the required point in the transformer. It is concluded that the location of the fault and the tank deflection characteristics are of primary importance in determining the pressures and deflections at the tank walls, but the presence and volume of the gas space has little effect except for faults close to the cover. M.R.Dickson

- 621.314.2  
 5371 INTERNAL FAULT CHARACTERISTICS OF GAS-INSULATED TRANSFORMERS. G.Camilli, L.G.Littlejohn and W.A.Wooldridge.  
 Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1779-84 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The causes of pressure rise due to internal arcing faults are discussed for liquid and gas-filled transformers, and experimental results obtained by initiating arcing faults in small oval transformer tanks are reported. Further results were obtained using a charge of explosive to represent more severe fault conditions, in circular tanks, filled with air, with and without relief diaphragms; and also in tanks partially filled with water, fitted with relief diaphragms. These tests indicated that for approximately equal peak pressures developed, transformer tanks when gas-filled are very much less liable to rupture than when liquid filled, and that relief diaphragms rupture more quickly after explosion in the gas-filled types. M.R.Dickson

- 621.314.2 : 621.316.5  
 5372 EQUIVALENT TRANSFORMER CIRCUITS FOR SWITCHGEAR TESTING. Moravová, Novotný and Pánek.  
 Elektrie, Vol. 14, No. 3, 93-7 (March, 1960). In German.

Members of the Prague switchgear testing station report on the development of an equivalent circuit for switching transformers without load. An air-core reactance and a damping resistance are connected to the low-voltage side of the step-up station transformer. A number of tests on real transformers and their equivalents are discussed. P.Linton

- 621.314.2  
 5373 A NEW APPROACH TO THE ANALYSIS OF IMPULSE VOLTAGES AND GRADIENTS IN TRANSFORMER WINDINGS. L.Rabins.  
 Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1784-91 (1960) = Pwr

Apparatus Syst., No. 46 (Feb., 1960).

Expressions are developed for the surge or high-frequency voltage distribution and voltage gradients in a single-layer transformer winding in terms of travelling and standing waves for infinite and finite winding lengths. Propagation characteristics of multi-circuit transmission lines serve as a basis for the analysis; the results are presented as infinite series for use with a computer. An approximate extension is possible to windings with more than one turn per section.

M.R. Dickson

621.314.2

**5374 PSEUDO-FINAL VOLTAGE DISTRIBUTION IN IMPULSED COILS AND WINDINGS.** P.A. Abetti.

Trans. Amer. Inst. Elect. Engrs III, Vol. 79, 87-91 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

In an impulsive transformer winding with grounded neutral, the difference is discussed between final voltage distribution (linear) and pseudo-final distribution (defined by Pirene, non-linear). The latter is determined by self- and mutual-inductance relationships of the winding. A method is developed for calculating it, approximating the actual mutual inductance function by linear or exponential functions. The theory is verified by measurements at 60 c/s.

M.R. Dickson

621.314.2 : 621.315.615

**5375 OIL PRESERVATION SYSTEMS; FACTORS AFFECTING IONIZATION IN LARGE TRANSFORMERS.**

A.T. Chadwick, D.H. Ryder and A.E. Brierley.

Trans. Amer. Inst. Elect. Engrs III, Vol. 79, 92-9 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

Gas bubbles may be released from super-saturated oil as a direct effect of dielectric stress across an oil space. Results are given of model tests designed to simulate conditions where small oil spaces occur in insulating structures showing bubble formation under stress and the chemical effects of corona across a gas space in the presence of oil and copper. Results are given of corona measurements on gas-pressure-system transformers in 60 c/s service up to 115% of normal service voltage both in the laboratory and in the field. The chemical processes described are slow in action. An oil conservator system or alternative design involving no appreciable oil-surface-pressure variation should eventually become the generally accepted system of oil preservation for large high-voltage transformers.

W.R. Stoker

621.314.2 : 621.311.161

**TRANSFORMER IMPEDANCE MATCHING.** See Abstr. 5311

621.314.2 : 621.316.722

**TECHNOLOGY OF APPARATUS FOR TRANSFORMER REGULATION.** See Abstr. 4746

621.314.212

**5376 THE DISTRIBUTION OF TEMPERATURE IN A COIL OF A TRANSFORMER WITH NATURAL OIL CIRCULATION.**

C.de Kuiper.

Electrotechniek, Vol. 38, No. 8, 215-21 (April 14, 1960). In Dutch.

The mean and the hottest-spot temperature rise of a coil above the oil are first calculated by a method (1) involving binomial coefficients. The assumption that the thermal conductivity inside the coil in the radial (horizontal) direction is constant gives a solution (2) expressible in term of hyperbolic functions. Assuming that the heat dissipation in the horizontal direction is independent of that in the vertical direction (3), a simple result is obtained. This method is usually of sufficient accuracy for calculation of the average temperature rise, but not for the hottest-spot temperature rise. The effect of unequal distribution of stray losses on the temperature rise is also discussed.

G.N.J. Beck

621.314.224

**5377 THE DESIGN AND PERFORMANCE OF HIGH-PRECISION AUDIO-FREQUENCY CURRENT TRANSFORMERS.** J.J. Hill and A.P. Miller.

Proc. Instn Elect. Engrs, Paper 3296 M, publ. Sept., 1960, 6 pp. To be republished in Vol. 108A (1960).

Current transformers of existing design are found to have large high-frequency errors. The causes of these errors are examined and it is shown that they are due to the high values of leakage inductance, self-capacitance and concentrated inter-winding capacitance that result from the conventional multi-layer form of construction. Greatly improved performance can be obtained if the

windings are arranged in uniformly-distributed single layers with a suitable thickness of insulation between them. Approximate formulae for calculating the various constants and errors of a transformer having single-layer windings are given, together with a design procedure for any specified limit of error over a wide band of frequencies. The practical aspects of the design are also discussed. Multi-ratio transformers in which all the ratios have virtually identical errors over a band of frequencies can be obtained by sub-dividing single-layer primary windings into sections, all of which are used by series-parallel connections for each ratio. Details are given of the design and performance of precision single-layer multi-ratio transformers rated from 5/5 to 400/5 amp. Their errors do not exceed 5 parts in  $10^5$  in ratio and 0.3° in phase over the frequency range 400 c/s-10 kc/s and are less than 2 parts in  $10^5$  and 1° over the range 50 c/s-10 kc/s.

621.314.241 : 621.331.3

**NEW "SLIPPING" NETWORK-COUPPLING CONVERTORS OF THE GERMAN FEDERAL RAILWAYS FOR 50/16 $\frac{2}{3}$  c/s, 31.25 MVA IN KARLSRUHE AND IN COLOGNE.** See Abstr. 4764

## POWER CONVERSION

621.314.261 : 621.316.718.5

**5378 THE PROBLEM OF DESIGN OF A CONTACTOR-TYPE FREQUENCY-CHANGER FOR THE REGULATION OF ASYNCHRONOUS MOTORS.**

M.V. Meerov, I.B. Semenov and V.Z. Yarina.

Avtomat. i Telemekh., Vol. 20, No. 1, 45-63 (1959). In Russian.

It is considered that of all available methods of speed control of asynchronous machines, the best appears to be regulation by change of supply frequency. Various aspects of the problem are dealt with and the results of an investigation are discussed. The main advantage of a current rectifier working in the inverted region is considered and some ways to solve the commutation problem are proposed. The device is illustrated and the scheme described in some detail. The contact rating of the experimental machine was 200 A.

J.S. Wilson

621.314.5

**5379 CURRENT CONVERTORS WITH TRANSISTORS.** P. Sirven.

Electricien, Vol. 88, 86-8 (May, 1960). In French.

Circuits are given for single- and bi-phase self-excited convertors (6 or 12 V input to rectified 150 or 250 V output) as well as of a driven convertor; the self-excited convertor is basically a vibrator, in which the mechanical contacts are replaced by transistors; the driven convertor is a transistorized class-C amplifier.

A. Sczaniecki

621.314.5

**5380 SOLID STATE POWER INVERSION TECHNIQUES. I.**

D.A. Paynter, B.D. Bedford and J.D. Harnden, Jr. Semiconductor Prod., Vol. 3, No. 3, 51-6 (March, 1960).

Reviews the development of inversion equipment up to the use of silicon controlled rectifiers and unijunction transistors. Five thyatron-type circuits commutating with static or counter-e.m.f. loads are considered.

E.F. Hansford

621.314.632

**5381 ON THE USE OF SEMICONDUCTOR RECTIFIERS ON ELECTRIFIED URBAN TRANSPORT.**

I.S. Efremov, N.A. Zagainov and S.S. Tikhomirov. Elektrichestvo, 1960, No. 1, 47-51 (Jan.). In Russian.

Discusses the advantages and disadvantages of semiconductor rectifiers (silicon, germanium, selenium) for use in substations and vehicles. A comparison is made between silicon rectifiers and traditional (mercury-arc) types, and some rectifier circuits described. It is shown that the use of semiconductor rectifiers for urban transport produces a reduction in energy losses, complexity and cost of the supply system.

Associated Electrical Industries (Manchester)

621.314.632 : 539.2 : 537.311

**5382 ON THE SURFACE CONDUCTIVITY OF CUPROUS OXIDE RECTIFIERS.** M.M. Kalabin and P.V. Sharavakii.

Fiz. tverdogo Tela, Vol. 2, No. 5, 657-62 (May, 1960). In Russian.



The V-A characteristics of a large number (~700) of Cu<sub>2</sub>O rectifying pellets of various diameter (2-7 mm) were determined. It was found that the reverse current depended not only on the conductivity of the pn-junction (volume current), but also on the surface conductivity (edge current), the latter becoming particularly apparent in pellets of small diameter. It was postulated that with increasing curvature of the edge of the pellet the number of the surface levels and, consequently, the surface conductivity increase.

M.H.Sloboda

621.314.65

**5383 PROSPECTS FOR THE USE OF SERIES CONNECTED VALVES AT LOW VOLTAGES.** L.S.Fleishman.  
Direct Curr., Vol. 4, No. 8, 226-9 (March, 1960).

The connection of mercury-arc rectifier valves in series, as distinct from the cascade connection of equipments, has only been general practice at voltages higher than can be supplied through a single valve; at lower voltages the procedure is controversial, some authorities maintaining that the theoretical reduction in backfire frequency is not obtained. Experiments on a heavily loaded 3.3 kV d.c. traction system in Russia are described. The rectifiers frequently backfired but this was virtually eliminated by the use of two valves in series, so that the rectifier rating could be considerably increased.

A.P.Wilmshurst

621.314.652 : 621.318.435.3

**GRID-CONTROL TECHNIQUE FOR CURRENT RECTIFIERS USING TRANSDUCTORS.** See Abstr. 4870

## POWER TRANSMISSION OVERHEAD LINES . CABLES

621.315.1

**5384 ARC-OVER ON 400 kV TRANSMISSION LINES.** A.S.Maikopar.  
Elekt. Stantsii, 1959, No. 6, 45-52 (June). In Russian.

The results are presented on an investigation into arc-over on transmission lines; experimental work was carried out on a 6 kV model, a 200 kV network, and also on a 400 kV line. The use of automatic reclosing equipment (both single-phase and three-phase) and the effects of arc-over are considered. The influence of reactors on these conditions is also examined.

Metropolitan-Vickers

621.315.1

**OVERVOLTAGES ON A TRANSMISSION LINE.** A.I.Skoibedo.  
Elekt. Stantsii, 1959, No. 7, 54-8 (July). In Russian.

Tests were carried out to determine the values of internal overvoltages on a 154 kV transmission line having auto-transformers without circuit-breakers on the h.v. side. Full details are given of the line and equipment. During the tests 35 disconnections were carried out under different conditions. It was found that the system without circuit-breakers yields much lower overvoltages and can thus be used for higher voltages on existing lines without strengthening the insulation. The overvoltages are still functions of the line parameters, however, and further investigations must be carried out to determine the actual relationships between these parameters and the overvoltages.

Metropolitan Vickers

621.315.1 : 621.316.57

**5386 AUTOMATIC RECLOSING ON THE VOLGA HYDRO-ELECTRIC STATION-MOSCOW TRANSMISSION LINE.** S.E.Stepunin and M.A.Fedoseev.  
Elekt. Stantsii, 1959, No. 8, 53-9 (Aug.). In Russian.

621.315.1

**5387 CALCULATION OF THE ACTIVE AND REACTIVE POWERS SUPPLIED AT THE SENDING END OF A LONG TRANSMISSION LINE WHEN THE VOLTAGE AT THE SENDING END AND THE POWER AND POWER FACTOR AT THE TERMINATION ARE KNOWN.** H.Rich and L.Gravier.

Reg. gen. Elect., Vol. 60, No. 4, 217-27 (April, 1960). In French.

Analytical as well as graphical methods of determining sending-end active and reactive powers are described. Direct calculation is laborious and the graphical method is to be preferred when calculations have to be performed frequently. Graphical methods developed in a previous study (see Abstr. 5053 of 1959) to determine the line voltage-drop are extended for this purpose.

A.S.Hay

621.315.145

**5388 THE MECHANICAL DESIGN OF STEEL-CORED ALUMINIUM CONDUCTORS.**

L.E.Ebin, M.S.Levin and M.T.Zbulin.

Elekt. Stantsii, 1959, No. 10, 71-4 (Oct.). In Russian.

The mechanical characteristics of steel-cored aluminium conductors with a single-wire steel core and a single lay of aluminium strand can be calculated from stress diagrams of steel and aluminium conductors. Maximum stress in the aluminium conductors can be taken as ~10 kg/mm<sup>2</sup>. The operating safety factors for 6-10 kV lines are the same as for the 70-120 mm<sup>2</sup> aluminium conductors on 35-220 kV lines.

Central Electricity Generating Board Digest

621.315.17

**5389 TWO EXAMPLES OF INDUSTRIAL RESEARCH IN FRANCE RELATING TO THE TRANSMISSION OF ELECTRIC ENERGY.** F.M.Cahen and R.A.Tellier.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1457-69 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

A review of research prior to the establishment of the French 380/420 kV system and the cable connection between France and England; the latter study was at first confined to a.c. and later directed to d.c. The transmission lines were to be largely 225 kV double-circuit suitable for later conversion to single-circuit 380 kV lines. Conductor sizes and configurations were investigated. The arrangement finally adopted for an ultimate 420 kV comprised twin conductors with a horizontal spacing of 18 in. For the d.c. cable the impregnated-paper-insulated "solid" type was finally preferred to the various types of pressure cables as the requirements to be met in putting the cables under pressure are not offset by any dielectric advantage.

A.P.Wilmshurst

621.315.17

**5390 ZERO-SEQUENCE CURRENT DENSITY IN THE EARTH.** M.E.Forsman.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1525-9 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Following Carson's treatment, equations are derived for the distribution of zero-sequence currents in the earth under a perfectly transposed 3-phase transmission line with earth return. Homogeneous ground conditions are assumed. Spatial graphs are presented showing the real and imaginary components of the zero-sequence current density as well as its magnitude and phase angle for a given line configuration.

R.H.Golde

621.315.17 : 621.315.661

**5391 DESIGNING LOW-COST TRANSMISSION LINES.** L.Haro and P.Haapanen.

Water Pwr, Vol. 12, No. 5, 181-8 (May, 1960).

On e.h.v. lines, towers present the best opportunity of reducing costs. In Finland guyed flexible towers are used for 220 kV and for 400 kV lines now under construction. Foundation blocks are transported during winter when temporary roads cost less. Increased knowledge should enable safety margins to be cut and justifies modification of safety codes where these are onerous.

A.P.Wilmshurst

621.315.171

**5392 230-kV VERSUS 60-kV SUBTRANSMISSION.** V.W.Ruskin and A.Langmuir.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1473-82 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The metropolitan area of greater Vancouver is some 290 square miles in extent and was originally fed at distribution voltages of 34 and 12 kV. A 60 kV system was installed during the Second World War but due to the extremely rapid rate of load growth the system required reinforcement by 1955; a series of load studies were therefore made to determine the best system for meeting the ultimate expected load of 900 MVA. An account is given of the features considered desirable in the future system and a comparative analysis presented of five different methods of supply. It was concluded that a superimposed 230 kV system stepping down directly to 12 kV distribution was both technically and economically superior to any scheme involving expansion of the existing 60 kV network.

M.Rathbone

621.315.171

**5393 MAINTENANCE WORK ON LIVE HIGH VOLTAGE TRANSMISSION LINES IN SWEDEN.** O.D.Zetterholm.

Rev. gen. Elect., Vol. 60, No. 5, 262-78 (May, 1960). In French.

A Swedish commission was formed in 1949 to study maintenance



methods on live lines as practised in the United States of America and the practicability of their adoption in Sweden. It was first necessary to draw up suitable safety regulations with particular reference to the danger of working on live lines during storms. Detailed technical instructions were then prepared for every operation. Only equipment of the highest quality may be used and extensive trials were performed with equipment of American origin. It was decided for reasons of economy to develop suitable equipment in Sweden and insulating rods made of a new plastic material have been produced as a result. The various tools which have been developed are described in detail and the regulations for their use quoted.

A.S.Hay

621.315.171

#### 5394 INTEGRATION OF BROWNLEE INTO THE IDAHO POWER COMPANY SYSTEM.

D.R.Russell, C.N.Teet, L.O.Evans and M.E.Byrne.  
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1507-13 (1960) = Pwr Apparatus Syst., No. 46, (Feb., 1960).

Brownlee is the 230 kV transmission station for the Hell's Canyon stations. Apart from links with adjacent systems, power is transmitted over a new steel-tower 2-circuit line to Boise Bench and then over a single-circuit wood-pole line to Brady. Substation busbars are of welded aluminium construction. Details of protective schemes are given.

P.Linton

621.315.2 : 621.317.2

THE HIGH-VOLTAGE RESEARCH LABORATORY OF THE  
N.V.NEDERLANDSCHE KABELFABRIEKEN AT DELFT.  
See Abstr. 4784

621.315.211

5395 INVESTIGATION OF THE IONIZATION CHARACTERISTICS OF CABLE INSULATION WITH VISCOUS IMPREGNATION. N.A.Voskresenskii and A.K.Mann.  
Elekt. Stantsii, 1959, No. 7, 58-63 (July). In Russian.

This investigation was carried out particularly with a view to establishing the safety of the cables in d.c. operation, for which the method used for a.c. cables is unsuitable. A new method is described and the ionization characteristics as functions of the voltage and of the duration of its application are presented and discussed. The d.c. characteristics are also compared to those with alternating voltages.

Electrical Research Association

621.315.211.2

#### 5396 GAS-FILLED CAVITIES IN SOLID-TYPE CABLES.

N.Klein.  
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 77-87 (1960) = Pwr Apparatus Syst., No. 47, (April, 1960).

Shape, size, gas pressure, and distribution of cavities are investigated in the oil-impregnated insulation of solid-type cables for the purpose of estimating dielectric strength. Possible cavity locations and the influence which acting forces and gas solution in the oil have on the cavities are discussed. Gas solution is treated as a diffusion process and the time variation of pressure in the cavities calculated. Cavity properties vary continually and the changes are discussed from manufacture to first operation, when the cable is put on load, and when it is cooling. Cavitation on cooling is treated, growing rate of new cavities and pressure drop across the insulation calculated, and the influence of cavitation upon the temperature rise limit considered. Corona occurrence is estimated with the help of this analysis of cavity properties. Means which diminish corona are discussed and compared with current practice in cable design. It is thought that cavity analysis might be usefully applied also to other apparatus with impregnated insulation, e.g., transformers and capacitors.

621.315.212.1

5397 A BRIEF REVIEW OF THE THEORY OF PAPER LAPPING OF A SINGLE-CORE HIGH-VOLTAGE CABLE.  
P.Gazzana Priaroggia, E.Occhini and N.Palmieri.  
Proc. Instn Elect. Engrs, Monogr. 390 S, publ. July, 1960, 10 pp.  
To be republished in Part C.

A brief outline of the theory of the lapping operation for high-voltage single-core paper-lapped cable is given, showing the stability conditions which the insulation thickness must satisfy in order that bending of the cable on the reel or capstan does not cause any damage to the insulation itself. An example of the design of a high-voltage cable is considered, showing the application of the theory outlined and its practical use.

5398

#### AMERICAN LEAD ALLOY CABLE SHEATHS. III.

S.A.Hiscock.

Elect. J., Vol. 164, No. 18, 1213-19 (April 29, 1960).

For Pt II see Abstr. 4011 of 1960. Summarizes the results of a long-term investigation on the mechanical properties of cable sheathing alloys by the Engineering Experiment Station of the University of Illinois. Arsenical alloy improves creep resistance and should prolong the life of some types of cable.

A.P.Wilmshurst

621.315.61 : 621.387

IONIZATION POWER AND IONIZATION CURRENT IN A DIELECTRIC WITH A SINGLE CAVITY. See Abstr. 5109

621.315.615 : 621.314.2

OIL PRESERVATION SYSTEMS; FACTORS AFFECTING IONIZATION IN LARGE TRANSFORMERS. See Abstr. 5375

## INSULATORS

### SUPPORTS . CONNECTIONS

(See also Insulating Materials)

621.315.62

#### 5399 ESTIMATION OF THERMAL PROPERTIES OF ELECTRICAL INSULATORS.

G.P.Boikov and V.B.Klyainerman.

Zh. tekh. Fiz., Vol. 30, No. 6, 741-2 (June, 1960). In Russian.

A method is provided for estimating the thermal properties of one insulator from the properties of another, with different heat conductivity, but working under the same temperature conditions.

J.K.Skwirzynski

621.315.624

5400 ON THE PROBLEM OF THE INSULATION OF 15-220 kV TRANSMISSION LINES IN LOCALITIES HAVING A POLLUTED ATMOSPHERE. O.G.Veksel'man.

Elekt. Stantsii, 1959, No. 11, 57-60 (Nov.). In Russian.

It is considered that the number and type of insulators for transmission lines should be selected with allowance for local atmospheric conditions. Types of atmospheric pollution are classified and corresponding lengths of insulator leakage path recommended for each type. The design of the insulators for different atmospheres is also considered. Reinforcement of the insulation will not guarantee freedom from flashovers, but it can reduce the number of faults occurring as a result. The question of cleaning insulators is briefly discussed.

Metropolitan-Vickers

621.315.624

#### 5401 SUSPENSION GLASS INSULATORS FOR POWER LINES.

N.A.Nikolaev, T.D.Andryukhina, V.A.Veselyi and S.I.Dyakovskii.

Elektrichestvo, 1960, No. 2, 41-6 (Feb.). In Russian.

A discussion of the development of strain in glass is followed by a description of the manufacture of a recently developed glass insulator type PS-4.5 which has an electro-mechanical strength of 4.5 t., the spacing is 5 in, the diameter of the disk is 10 in, and the weight of the glass component is 2.5 kg. The design of another insulator, type PS-8.5 is still to be approved. Details of dimensions and mechanical and electrical characteristics of single and multiple assemblies of PS-4.5 type insulators are discussed with reference to various tests which have been carried out. Some comparison is drawn between Russian-made insulators and those produced in other countries. References are made to the relative merits of glass and porcelain insulators.

E.M.Dembinski

621.315.624 : 621.317.333

#### 5402 A.C. FLASHOVER VOLTAGE OF LONG INSULATOR STRINGS IN HIGH-VOLTAGE LABORATORIES AND OPEN-AIR TESTING STATIONS. W.Mosch.

Elektrie, Vol. 14, No. 3, 101-3 (March, 1960). In German.

The flashover voltage of long strings of insulators is liable to be affected by the distribution of their stray capacitances to earth. With a view to determining this effect indoor and outdoor tests were performed on long-rod insulator assemblies suitable for 380 kV

systems. The results are statistically evaluated and it is found that dry flashover values in open air are about 10% higher than values obtained indoors.

R.H.Golde

621.315.65

**5403 NEW FITTINGS FOR TRANSMISSION LINES WITH GROUPED PHASE CONDUCTORS.** Yu.E.Grigor'ev. Elekt. Stantsii, 1959, No. 8, 37-40 (Aug.). In Russian.

Description of a complete set of overhead line fittings for 500 kV with grouped conductors. These fittings are suitable for the straight sections of line and with intermediate supports fitted with releasing clamps and will result in the elimination of some losses during operation caused by the use of the old types of fittings.

Electrical Research Association

621.315.661 : 621.315.17

**TOWER DESIGN FOR CHEAP TRANSMISSIONS LINES.** See Abstr. 5391

621.315.668.2

**5404 FRACTURE RESISTANCE OF PILE FOUNDATIONS UNDER METAL TRANSMISSION LINE TOWERS.** G.S.Ter-Ovanesov. Elekt. Stantsii, 1959, 75-8 (Oct.). In Russian.

A discussion of the requisite features of reinforced-concrete pile foundations for the metal towers of power transmission lines, and particularly their bearing capacity and resistance to fracture, is accompanied by examples showing the calculation involved.

Central Electricity Generating Board Digest

621.315.668.3

**5405 CONCRETE SUPPORTING POLES FOR MEDIUM VOLTAGE LINES WITHOUT SOLID FOUNDATIONS AND WITH ROTATABLE CROSS-BEAMS.** H.Knobloch. Elektrizitätswirtschaft, Vol. 59, No. 3, 67-9 (Feb. 5, 1960). In German.

The widespread adoption of mechanical methods in farming makes it essential that the number of pole supporting points is reduced to an economical minimum. The distance between poles can be increased when concrete instead of wooden poles are used and the increased cost is offset by lower maintenance expenses especially where the line is planned to be in position for a considerable period. A concrete pole design with rotatable cross-beam is suggested in order to achieve a lighter and cheaper construction. The semi-spherical bearing does not contain any metallic parts and requires no maintenance. A further reduction in weight is obtained by the use of two reinforced concrete foundation plates instead of the customary block foundation. Curves are plotted to illustrate the characteristics of this design assuming St-Al 70/12 mm<sup>2</sup> conductor tensioned at 11 kg/mm<sup>2</sup>.

A.S.Hay

621.315.68

**5406 PROBLEMS OF CLAMPS ON ELECTRIC POWER LINES.** J.Nefzger and B.K.Hansen. Elektrotekniker, Vol. 56, No. 9, 188-92 (May 7, 1960). In Danish.

The design of suspension clamps, straining clamps and line connectors is discussed. Current distributions in four different clamp designs are shown in a diagram and contact properties are illustrated by curves showing voltage drop against torque of clamping screws and clamping pressure. A comparison is made of the performance on load tests (currents of 8-12.5 kA and temperatures of 200-300°C) of clamps of old and new design, the results being expressed as the voltage drop in mV at 530 A and 20°C.

G.N.J.Beck

621.315.684

**5407 NEW LINE-UP TERMINALS.** J.Schmitt. Siemens - Z., Vol. 34, No. 4, 278-80 (April, 1960). In German.

The reliability of a terminal connection depends on the design of the terminal and also on the section of the materials used. Line-up terminals for conductors with a cross-section of 2.5 mm<sup>2</sup> have been developed for locations where space is restricted. In the larger sizes the range of NRK line-up terminals has been extended by two units for conductors up to cross-section of 95 and 185 mm<sup>2</sup>. Special clamping pieces, which can be swung out, permit the conductor to be inserted from above without special preparation of the conductor ends, a feature which appreciably reduces the time required for installation, and thus the costs.

621.315.687 : 621.039

**5408 GASTIGHT CABLE BUSHINGS IN THE KARLSRUHE REACTOR FR 2.** K.Hitzig. Siemens - Z., Vol. 33, No. 10, 630-4 (Oct., 1959). In German.

An essential difference between the methods required for installing the measuring and control equipments in the Karlsruhe research reactor and those normally applied for the installation of electrical systems in plants of similar extent, such as power stations, consists in the fact that in the reactor building, in which the atmospheric pressure is below that of the outer air, all conductors must be brought out through gastight bushings. Two types of gastight bushings have been developed. One of them is constructed as a distribution terminal composed of parts used in telephone engineering, while the other is a special design made gastight with the aid of cast-resin. It is explained why two different types must be used and the constructional features as well as the materials chosen are discussed.

## DISTRIBUTION . INSTALLATIONS

621.316.1

**5409 DETERMINATION OF THE DEGREE OF RELIABILITY AND THE EXTENT OF STANDBY IN URBAN SUPPLY NETWORKS.** I.S.Besmertnyl and R.Ya. Fedosenko. Elektrichestvo, 1959, No. 11, 20-7 (Nov.). In Russian.

The problem of the degree of selective and automatic switching of standby which should be used to ensure a satisfactory level of reliability and continuity of supply to the various classes of consumer is discussed. The necessary data and methods of estimation of the reliability of supply network are given. Besides duration of the failure (as prescribed by regulations), the time interval between recurrences of the fault is also taken into account in estimating reliability of network components. Worked examples illustrate the method of determination of reliability indices and their application. It is concluded that the significance of reliability indices for characteristic conditions and schemes (with due allowance for protection failures), indicate that, in urban supply networks, it is sufficient to limit selective automatic switching of standby to consumers requiring a high degree of reliability of supply.

W.J.Grek

621.316.1

**5410 60 kV INSTALLATION ON BORNHOLM.** J.Boesen. Elektrotekniker, Vol. 56, No. 9, 184-7 (May 7, 1960). In Danish.

The island's supply system, which is quite independent of that of Denmark or Sweden, was at 10 kV until the 60 kV system described began operation in late 1959. About half of the island's load is carried by the capital, Rønne, and surroundings. An open-air transformer station was built at Rønne and comprises two 10/60 kV 4 MVA transformers. Flat 60 kV cables are used for 1.2 and 3.2 km runs in the built-up areas. Two further substations are at Olsker and Bodilsker, each with one 4 MVA transformer. No 60 kV breakers or current transformers are used owing to the simplicity of the system and the low short-circuit power (90 MVA) likely to arise. In the event of a 60 kV line fault the corresponding impedance relay brings out a breaker on the 10 kV side of the transformer.

G.N.J.Beck

621.316.11

**5411 PRESENT AND FUTURE SERVICE VOLTAGES.** G.Hameister. Elektrizitätswirtschaft, Vol. 59, No. 3, 53-7 (Feb. 5, 1960). In German.

Continuous development in the production of insulating materials has led to a very large number of service voltages as is demonstrated by the fact that in 1957 there were 46 different network service voltages in West Germany alone. Standard service voltages have been laid down by the International Electrotechnical Commission. The progress made by various European countries in standardizing their service voltages according to the I.E.C. recommendations is reviewed.

A.S.Hay

- 621.316.11 : 681.142  
 5412 **PLANNING IN MEDIUM-VOLTAGE SUPPLY SYSTEMS WITH THE HELP OF THE DIGITAL COMPUTER.**

W.Mollwitz.

Elektrizitätswirtschaft, Vol. 59, No. 7, 188-95 (April 5, 1960). In German.

In the autumn of 1959, the Energieversorgung Ostbayern AG (OBAG) of Regensburg carried out calculations with the help of the I.B.M. 704 digital computer for the purpose of system planning. The problems are first stated in general terms insofar as they relate to the supply system. Methods are considered of handling the data and feeding it to the computer. An outline is then given of the computer programme. The progress of the calculations is followed up to the presentation of the results. These are discussed in detail with two particular network problems taken as examples. It is shown that, by using a computer, system problems can be solved quickly and easily and that planning for the future is possible.

E.W.Golding

- 621.316.11 : 681.142  
 5413 **A NEW METHOD OF MAKING TRANSMISSION LOSS FORMULAS DIRECTLY FROM DIGITAL POWER FLOW STUDIES.** E.E.George.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1567-73 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The constants in the loss formula are obtained directly from digital power flow studies by: (1) setting up a base case power flow at any convenient seasonal or daily load level where ratios between substation loads are typical; (2) scheduling power generation at each source on a typical schedule and carrying out a computer power flow study, including total losses to great accuracy (probably better than 0.1%); (3) study in as many other generating schedules as are required to solve the simultaneous equations, i.e., one for each constant, without changing the load schedules and without changing the generation by more than  $\pm 20\%$ ; and (4) working out the constants algebraically from these results. This method is estimated to save about 50% of the time required by present methods.

G.A.Montgomerie

- 621.316.11 : 681.142  
 5414 **DIGITAL SOLUTION OF SHORT-CIRCUIT CURRENTS FOR NETWORKS INCLUDING MUTUAL IMPEDANCES.**

A.L.Toalston.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1720-5 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Presents a method for the digital computer solution of a short-circuit tensor and its use for the calculation of currents in three-phase power systems with lines having mutual impedances. The basic data and assumptions are as for network analyser studies. The short-circuit tensor may be modified for line additions, deletions or line-open conditions, eliminating the necessity for lengthy calculations for each fault condition. Networks may be divided into parts and the short-circuit tensor solved for each section. Short-circuit tensors can be derived for positive- and zero-sequence networks of a system and the same programme used for both phase- and earth-current calculations. Fixed-point arithmetic and scalar quantities rather than complex numbers are used to minimize the storage requirements and computing time.

D.J.Truslove

- 621.316.11  
 5415 **THE STANDARDIZATION OF LOW VOLTAGE FOR DISTRIBUTION IN BELGIUM.** H.Lhussier.

Votre Electricite, Vol. 31, 33-40 (April, 1960). In French.

A discussion of the advantages of standardization based on statistical figures for Belgium and its neighbours. It has been decided to have 2 standards: (a) 3 ph. 3-wire with 220 V line-voltage; or (b) 3 ph. 4-wire with 380 V line and 220 V ph. voltage. The procedure for the change-over is described and the allocation of the cost to the various parties concerned is suggested. The direction of future development is indicated.

R.G.Jakeman

- 621.316.13  
 5416 **GUIDE FOR THE DESIGN OF LOW-VOLTAGE SYSTEMS.** W.H.Htscher.

Elektrie, Vol. 14, No. 4, 138-44 (April, 1960). In German.

A general review of the various types of distribution system and their relative advantages for different types of consumer. A useful table shows the load density for the various towns and districts of

East Germany. It is suggested that it is economically justified to change from a radial to a mesh system when the load density reaches 1 MVA/km<sup>2</sup>.  
 P.Linton

## SWITCHGEAR

- 621.316.5  
 5417 **FUNDAMENTAL LAWS ON THE IMPULSE STRENGTH OF THE INSULATION IN AIR-FILLED SWITCHING APPARATUS.** M.I.Sysoev.

Elektrichestvo, 1960, No. 1, 63-8 (Jan.). In Russian.

Results of investigations of the insulation of air-filled switching apparatus are described. These investigations were carried out using the standard impulse wave of 1.5/40  $\mu$ s. The voltage was raised in stages of 4%, the voltage at the first stage being 90% of the minimum breakdown voltage at industrial frequency. The range of air pressures was from 1-17 atm. The effect of small particles on the field between the electrodes is discussed, and the influence of the air pressure on the breakdown intensities examined.

Associated Electrical Industries (Manchester)

- 621.316.5  
 5418 **INVESTIGATION OF THE EXTINCTION PROCESSES OF A FREE A.C. ARC.** I.S.Taev.

Elektrichestvo, 1960, No. 4, 57-63 (April). In Russian.

Determines the conditions in which a free (open) a.c. arc is extinguished at the contacts of interrupting apparatus in the first passage of the arc current through zero. These conditions depend on the parameters of the interrupting apparatus and the network being interrupted. The author examines: the natural frequency of low-voltage networks, the length of a free arc and its speed, the rise in recovery strength of the free arc column, and the "strength around the cathode" in an a.c. arc.

Associated Electrical Industries (Manchester)

- 621.316.5  
 5419 **EXTINCTION OF AN OPEN ELECTRIC ARC.** A.S.Maikopar.

Elektrichestvo, 1960, No. 4, 64-9 (April). In Russian.

Independent extinction of arcs developing in high voltage installations can prevent interruptions in service and the conditions necessary for such extinction have been widely studied. An attempt is made to specify these conditions more precisely. Definitions are given of the static volt-ampere characteristic of an open electric arc, dynamic parameters of such an arc, critical length, and extinction time.

Associated Electrical Industries (Manchester)

- 621.316.5  
 5420 **REINFORCEMENT OF H.V. NETWORKS FOR INCREASED ENERGY DEMAND AND RELIABILITY OF SUPPLY.**

F.Parschalk.

B.B.C. Nachr., Vol. 42, No. 6-7, 297-316 (June-July, 1960). In German.

An illustrated review of Brown Boveri switchgear and control equipment for use on systems up to 380 kV.  
 A.P.Wilmschurst

- 621.316.5 : 621.314.2  
 EQUIVALENT TRANSFORMER CIRCUITS FOR SWITCHGEAR TESTING. See Abstr. 5372

- 621.316.5.066.6  
 5421 **INCREASING THE RESISTANCE TO WEAR OF THE CONTACTS OF HIGH-VOLTAGE ISOLATING DEVICES.** I.G.Korovyakovskii.

Elekt. Stantsii, 1959, No. 6, 42-5 (June). In Russian.

Deals with the wear of moving contacts used for periodic closing and opening of electric circuits with load and without load. The faults and qualities of contacts made of copper and copper alloys, contacts with a silver surface, and metal-ceramic contacts (metal-tungsten materials) are considered. Methods of reducing contact resistance are examined. The metal-ceramic materials are examined in detail and individual items briefly described. 6 references.

Metropolitan-Vickers



- 621.316.54  
5422 THE MEASUREMENT OF ELECTROSTATIC CORONA ON HIGH-VOLTAGE SWITCHGEAR AND INSULATORS. T. Mukutmoni.

Siemens - Z., Vol. 33, No. 8, 509-16 (Aug., 1959). In German.  
Deals with the measurement of high-frequency disturbance produced by corona on switchgear. It then gives a physical explanation of the disturbance phenomena and describes various kinds of disturbances, which can arise on high-voltage switchgear. Measurements, which were taken previously, are used to plot a number of curves, and atmospheric effects are discussed, particularly those due to rain, dew and contamination.

- 621.316.57  
5423 A NEW SERIES OF EARTH-LEAKAGE CIRCUIT BREAKERS WITH HIGH RUPTURING CAPACITY. R. Scherbaum and F. Edlmayr.

Siemens - Z., Vol. 34, No. 4, 229-31 (April, 1960). In German.  
A description is given of a new series of earth-leakage circuit breakers in which the fault current is passed through a core-balance transformer. This energizes a lockout magnet thereby unlatching the breaker trip mechanism. The magnet, a field-proven type with small dimensions, responds to very low currents, providing the breaker with a high degree of sensitivity and independence of the system. The new earth-leakage circuit breakers have a high rupturing capacity, and can be used for normal operational switching.

- 621.316.57.064.24  
5424 BEHAVIOUR OF AIR-BREAK CIRCUIT-BREAKERS WHEN BREAKING SHORT-CIRCUIT CURRENTS BETWEEN TWO OR THREE PHASES AND EARTH. Y. Pelenc.

Bull. Soc. Franc. Elect., Vol. 1, 219-26 (April, 1960). In French.  
A dangerous overvoltage can appear when a circuit-breaker has to rupture simultaneous faults between 2 phases and earth on a 3-ph. network, the neutral of which is connected to earth by a reactance. This overvoltage is theoretically independent of the circuit-breaker. However, in practice, its value can be modified by the behaviour of the breaker. This occurs particularly in the case of air break with long arcs in which the resistance of the arc often becomes high and has a considerable effect on the conditions leading to overvoltages. Different types of current-rupturing processes which can occur with this class of apparatus are examined.

- 621.316.57.064.24  
5425 PERFORMANCE OF THE INSULATION OF AIR-BLAST CIRCUIT-BREAKERS IN HOT CLIMATES. A. I. Dobrusin and S. M. Sirotkin.

Elekt. Stantsii, 1959, No. 5, 62-4 (May). In Russian.  
No condensation will take place inside the pillar insulator or air piping of air-blast breakers if the normal supply of scavenging air is maintained, i.e. 400-450 l/hr. Since the quality of the insulation and safe and reliable operation of the breaker depends mainly on the exclusion of moisture, the tightness of the seals must be permanently supervised and scavenging with double the above quantity of dry air carried out for 5-6 hr before taking breaker into service.

Electrical Research Association

- 621.316.57.064.24  
5426 EXPERIENCE WITH METHODS OF EXTENDING THE CAPABILITY OF HIGH-VOLTAGE AIR BREAK SWITCHES. E. C. Rankin.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1634-7 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).  
Describes tests on a motor-operated 138-kV air-break switch including line dropping, load separation and de-energizing a 300 MVA transformer bank. Tests were also made with a 345-kV air-break switch with a gas-blast device which directed a jet of nitrogen or air at 225 lb/in<sup>2</sup> on the arc at the moment when the blade and jaws started to separate.

- 621.316.57.064.25  
5427 HIGH-POWER LABORATORY TESTS ON HIGH-CAPACITY HIGH-VOLTAGE OIL CIRCUIT BREAKERS. N. E. Reed and E. B. Riets.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1486-93 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).  
Describes tests made to supplement field tests on two single-pole units at 69 and 115-230 kV to establish their interrupting

characteristics and ultimate limits. The results are tabulated and those of earlier field tests are included for comparison. The ratings covered a range from 3500-15 000 MVA. A. P. Paton

- 621.316.57.064.25  
5428 TWENTY YEARS' EXPERIENCE WITH OUTDOOR SINGLE-TANK OIL CIRCUIT BREAKERS. S. Clare and W. O. Rowan.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1501-6 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).  
Reviews operating experience with such breakers in the 15-138 kV range of which there are some 1750 in service on the Ontario Hydro system. Design characteristics are described and from the point of view of cost and reliability it is concluded that the inclusion of 3 phases in a single tank is justified. Maintenance is easier and less expensive. A. P. Paton

## REGULATION

- 621.316.7 : 621.311.21  
5429 FREQUENCY MAINTENANCE, POWER REGULATION AND OTHER PROBLEMS IN A MODERN HYDRO-ELECTRIC STATION. R. Comtat.

Bull. Assoc. Suisse Elect., Vol. 51, No. 10, 515-20 (May 21, 1960). In French.

A description of the control system for the Grand Dixence scheme comprising 2 stations each having 6 identical sets of 75 000 and 90 000 h.p. respect. The controller supervises the power interchange with the adjacent network and alters the turbine governor settings, ensuring also that the flow through the two stations in cascade remains constant. The control is based on the integrated power-frequency system, the control signal being proportional to the actual power setting required. P. Linton

- 621.316.718 : 621.34  
5430 CONTROL METHODS FOR TWIN DRIVES FOR HOT-AND COLD-ROLLING MILLS. H. R. Bill.

Elektrotech. u. Maschinenbau (E. u. M.), Vol. 76, No. 23, 563-74 (Dec. 1, 1959). In German.

Twin drives have been found to be superior to gear drives for slabbing and blooming mills as well as for cold-rolling mills since the ratio between the upper and lower roller speeds can be varied continuously to suit the conditions prevailing. Mercury-arc rectifiers are preferred to rotary converters for the d.c. supply for economic reasons and because of their relative ease of installation. Reversal of rolling direction is obtained by reversing the driving-motor fields. Control requirements in the case of cold-rolling mills are particularly severe as separate drives are required for the strip storage reels. The Contiflux method of control, which has been developed to meet this duty, is described. The exciter current circuit must be designed carefully to overcome the magnetic inertia of the motor field and impulse excitation is used when reversing. Results obtained with this type of control are illustrated and the stability of the control circuit is analysed.

A. S. Hay

- 621.316.718 : 621.34  
5431 THE ELTOR SYSTEM FOR SYNCHRONOUS SPEED CONTROL OF SECTIONAL DRIVES ON PAPER MACHINES. F. Schiller.

Siemens-Z., Vol. 34, No. 4, 201-3 (April, 1960). In German.  
The Eltor system serves for the synchronous speed control of section drives. The equalizing currents flowing between two transmitters when a synchro-tie system is subjected to electric torsion are passed through a transformer. The current induced into the secondary side is then fed directly or via a control amplifier to the motors to be controlled. Details of the circuit arrangement and of the degree of accuracy obtained are given.

- 621.316.718 : 621.34  
REGULATION OF THE DRIVE OF THE FINISHING SET OF A CONTINUOUS STRIP ROLLING MILL. See Abstr. 4771

- 621.316.718.5  
5432 A REVERSING SYSTEM FOR AUTOMATIC SPEED CONTROL WITH ELECTROMAGNETIC POWDER CLUTCHES. T. A. Glazenko.

Elektrichestvo, 1960, No. 4, 21-6 (April). In Russian.  
Describes some control systems and examines the problems of



the calculation of the static and dynamic characteristics of reversing speed-control systems with electromagnetic powder clutches. Tests on a number of experimental installations for speed control have shown that these clutches improve the quality of the system, reduce its dimensions and weight, increase its speed of operation, and in certain cases improve the power factor.

Associated Electrical Industries (Manchester)

621.316.718.5

- 5433 THE CONTROL OF HIGH-SPEED COIL PREPARATION LINES OF THE TIGHT-LINE TYPE. J.T.Bentley. Engl. Elect. J., Vol. 16, No. 5, 31-46 (March, 1960).

The function of the coil preparation line at the Velindre works of the Steel Company of Wales is to provide facilities for inspection, side trimming and seam welding to produce coils for tinning up to 36 000 lb in weight, 72 in. in diameter and from 0.006 to 0.024 inches thick. Maximum speed of the line is 4000 ft/min and the control scheme is required to maintain constant speed and constant strip-tension in all conditions of operation. A detailed account is given of the design considerations involved in the Ward Leonard loops to achieve this result; block schematic diagrams are included.

M.Rathbone

621.316.718.5 : 621.395.625.3

- 5434 TRANSISTORIZED MOTOR SPEED CONTROLS FOR SATELLITE TAPE RECORDERS. M.B.Pickover. Proc. Inst. Radio Engrs., Vol. 48, No. 4, 725-8 (April, 1960).

Discusses problems arising in the design of an a.c. transistorized power supply for low power synchronous motors used in satellite recorders. It treats a current design for a specific satellite application, presents the design of the overall system, and states alternate methods that can be used. The overall system parameters which must be considered in the choice of a hysteresis synchronous motor, the motor's operating frequency, and its characteristics are also discussed. A transistorized d.c. motor control used in a tape recorder is also considered. The servo loop used to accomplish the control of speed and the accuracy that may be obtained are discussed. Diagrams of the exact circuit are presented and analysed. The relative advantages and disadvantages of the d.c. motor and a.c. synchronous motor in the low-power output range are discussed. The system is designed to meet the environment of the satellite packages. The emphasis is on a system requiring a minimum of power consumption and smallest possible size and weight, with no sacrifice of reliability or performance.

621.316.719 : 621.335.2

- APPLICATION OF TRANSDUCERS AND TRANSISTORS TO BRAKING FOR ELECTRIC LOCOMOTIVES. See Abstr. 4766

621.316.722

- 5435 D.C. VOLTAGE REGULATOR USING TRANSISTORS. P.Sirven. Electricien, Vol. 88, 118-21 (June, 1960). In French. It replaces a carbon-pile regulator or a vibrator-type regulator in controlling the output voltage of rotating d.c. generators. A Zener diode is used as reference followed by a switching circuit of two transistors and a power transistor amplifier to feed the field winding of the generator.

A.Sczaniecki

621.316.722 : 621.313.322

- 5436 NEW AUTOMATIC ELECTROMAGNETIC EXCITATION REGULATORS FOR SYNCHRONOUS MACHINES.

O.M.Kostyuk, V.E.Rybinskii and L.V.Tsukernik.

Elekt. Stantsii, 1959, No. 11, 41-7 (Nov.). In Russian.

A description of the special features and characteristics of the UBK-3 regulator intended for large generators. The circuit in the new regulator has been greatly simplified, and the total weight reduced by half for the same rating. Details are given of systems of group excitation regulation and excitation limiting systems containing the new excitation regulators. 6 references.

Metropolitan-Vickers

621.316.722 : 621.313.322

- 5437 GROUP EXCITATION REGULATION FOR THE HYDRO-GENERATORS OF THE TSIMLYANSK POWER STATION. R.N.Marakov, V.M.Pokrovskii and I.E.Ponomarenko. Elekt. Stantsii, 1959, No. 11, 48-51 (Nov.). In Russian.

Maximum use is made of contactless elements, which are the most reliable for continuous regulation. The exciters, central voltage regulator, measuring elements, compounding system and other

features are described. The system ensures accurate distribution of the reactive load between the generators, and is reliable and convenient in operation.

Metropolitan-Vickers

621.316.722 : 621.311.1

- 5438 USE OF THE TRANSFORMER FOR REGULATION PURPOSES. H.Langer.

Elektrotech. Z. (E.T.Z.) A, Vol. 81, No. 7, 262-9 (March 28, 1960). In German.

Because of the effect of reactances in the network, the maintenance of voltage (in contrast to maintenance of frequency) is of importance to every section of the system. As voltage is related to reactive power, the regulating effect of a transformer can be deduced from the voltage against reactive-power characteristics of the network. Characteristic curves are derived for various types of networks and interpretation of curves is explained. Bad voltage conditions cannot be compensated by regulating transformers even with particularly wide regulation range. In interconnected systems practical regulation range is  $\pm 15\%$ . From operational and economic aspects, power-factor correction should be employed to keep regulation within this limit. Feeding of the output of a power station into an interconnected system is improved by control of the generator transformers. On-load tap-changers with a quick response mechanism and transition resistors are used for adjustment of voltage under load. On-load tap-changers were constructed for maximum voltages of 220 kV and rated current of 1500 A for three-phase units, and 220 kV at 2000 A for single-pole units.

W.J.Grek

621.316.722

- 5439 TRANSISTORIZED REGULATION AND CONTROL OF AIRCRAFT ELECTRICAL POWER SYSTEMS.

K.F.Bacon.

Proc. Instn. Elect. Engrs., Paper 3266 U, publ. Aug., 1960 (Vol. 107A, 343-52).

Describes an attempt to replace with solid-state devices the carbon-pile regulators and electromechanical protective circuits in a representative aircraft's power system. A complete 2-generator d.c. system has been built and found to give substantial improvements in performance over a conventional system. The only electromechanical device used was a 400 amp d.c. contactor. A new approach to generator protection, relying on a knowledge of its excitation characteristics, is also described. There seems to be no reason why similar principles should not be applied to a.c. systems.

621.316.722 : 621.316.1

- 5440 VOLTAGE REGULATION IN DISTRIBUTION SYSTEM[S]. R.Hihara.

Researches Electrotech. Lab. (Tokyo), No. 576, 3 pp. (June, 1959). In Japanese.

Results of investigations in other countries are first studied and then experiments under the following broad general headings are described. (1) Relations between spread of voltage regulation in the distribution substation and the voltage drop in primary and secondary feeders. (2) Incremental load demand related to voltage regulation in metropolitan, urban and rural distribution networks. (3) Automatic voltage regulation systems. (4) Improvement of voltage regulation in various types of distribution network. (5) Consideration of future problems.

621.316.722

- 5441 EXTENSION OF THE LOAD RANGE OF TIRILL REGULATORS. I-II. W.Leonhard.

Regelungstechnik, Vol. 8, No. 2, 37-42 (Feb.); No. 4, 119-23 (April, 1960). In German.

Surveys various possibilities of relieving the load contacts of Tirill regulators. Of particular interest is a method whereby a transducer-controlled pulsating current is superimposed on the current through the load contact so that the contact current itself becomes pulsating or alternating. By this means, losses in the closed contact and the switching load are reduced considerably and the output current of the regulator can be increased by a factor of 2 or 3. This results in an extension of the power range of the Tirill regulator while employing the same output relays.

621.316.722 : 621.318.435.3

- VOLTAGE REGULATION OF A FREQUENCY CONVERTOR BY MEANS OF TRANSDUCATORS. See Abstr. 4868

621.316.722.1 : 621.355.163

## 5442 MAGNETIC AMPLIFIER CONTROL OF METALLIC RECTIFIERS. G.B.Meemamsi.

Telecommunications (Jabalpur), Vol. 9, No. 1, 3-15 (June, 1959).

Describes the basic principles of magnetic amplifiers and their application in voltage regulation of metallic rectifiers suitable for floating and charging telephone-exchange and repeater-station batteries.

621.316.728 : 621.316.1

## 5443 THE AUTOMATIC CONTROL OF REACTIVE POWER IN THE NETWORK. R.Modlinger.

Elektrizitätswirtschaft, Vol. 59, No. 5, 124-7 (March 5, 1960). In German.

Until recently, reactive power in the network has been controlled satisfactorily by manual methods. With the control equipment in current use, operation of alternators under weakly excited conditions has given rise to stability problems. The automatic control of reactive power has several important advantages. The technical requirements which have to be met are first stated and it is then shown how a practical form of automatic control may be achieved. This is illustrated by a schematic diagram. Consideration is then given to the implications of automatic control upon machine design. The effects of both long and short system disturbances are described.

E.W.Golding

621.316.728 : 621.311.21

## ELECTROHYDRAULIC GOVERNORS AT BEECHWOOD GENERATING STATION. See Abstr. 5315

621.316.728 : 621.311.161

## RESULTS OF NEW CIRCUIT-BREAKING TESTS IN THE WESTERN EUROPEAN POWER NETWORKS FOR THE DETERMINATION OF REGULATION PARAMETERS. See Abstr. 5310

621.316.729 : 621.313.322

## SELF-SYNCHRONIZATION OF GENERATORS.

5444 L.V.Krasil'nikov and V.K.Meshkov.

Elekt. Stantsii, 1959, No. 11, 34-41 (Nov.). In Russian.

Deals with the question of the self-synchronization of generators "from zero" during voltage recovery in a power system. A new method of raising the system voltage from zero with several generators of different power stations, with self-synchronization of these generators, was tested. A description is given of the test and some results. The test show that the method is practicable and leads to more rapid voltage recovery after system breakdowns than earlier methods. At the moment, more investigations into the effect of individual factors on the self-synchronization process are needed.

Metropolitan-Vickers

621.316.74 : 621.316.825.4

## 5445 TEMPERATURE STABILIZATION OF THE BODY OF AN INDIRECTLY HEATED THERMISTOR. N.P.Udalov.

Avtomat. i Telemekh., Vol. 19, No. 11, 1070-2 (1958). In Russian.

Stabilization is achieved by shunting the heater element with a directly heated thermistor, this parallel combination being fed by constant current, achieved either by a large series resistor or by a barretter. Characteristics of both directly and indirectly heated thermistors are shown and employed for the graphic solution of the stabilization problem. A typical example is calculated in detail: for an ambient temperature change from 0° to 50°C, the thermistor body temperature remains at 70° ± 4°C. [English summary: PB141096T-12, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C.].

A.Landman

621.316.74 : 536.58

## 5446 TEMPERATURE REGULATOR FOR CLOSE TEMPERATURE CONTROL. E.N.Hiersberg.

J. sci. Instrum., Vol. 37, No. 8, 285-9 (Aug., 1960).

The design and performance of an electronic temperature regulator for an analytical oven of special construction is described. Stable temperature control with a resettable of better than 1°C is obtained over the range of 150-550°C. Residual peak-to-peak temperature fluctuations in the oven are less than 0.015°C.

621.316.74

## 5447 STUDY OF AN ENCLOSURE WITH ELECTRONIC TEMPERATURE REGULATION. J.C.Bonnaire.

Schweiz. tech. Z. (S.T.Z.), Vol. 57, No. 20, 423-5 (May, 1960). In French.

A simple study of the heat balance of a small low-temperature

oven where radiation effects can be neglected. A simple circuit using a thermistor sensing element and a non-temperature-compensated transistor d.c. amplifier with relay control of the heating supply is shown, which will stabilize the oven to better than 1°C over the set temperature range 50-70°C.

W.D.Gilmour

## PROTECTION

621.316.9

## 5448 NECESSITY AND PROTECTIVE VALUE OF METALLIC SHEATHS FOR SECONDARY CABLES IN EXTRA HIGH VOLTAGE PLANTS AND IN HIGH MOUNTAIN GALLERIES, AS AN EXAMPLE OF THE PROTECTIVE EFFECT OF GENERAL FARA-DAY CAGES. K.Berger.

Bull. Assoc. Suisse Elect., Vol. 51, No. 11, 549-63 (June 4, 1960). In German.

Dangerously high overvoltages were observed between the cores of a measurement cable and the steel frame of the building in a Swiss power station. This phenomenon was examined using the original thermoplast cable without metallic sheath and a lead sheathed cable. It was found that the overvoltages were considerably reduced when unused cores were earthed at both ends of the cable. The use of a metallic sheath caused the overvoltages to disappear almost completely. The theoretical aspects of the problem are discussed and experimental techniques are described.

A.S.Hay

621.316.925

## 5449 TESTS ON THE PROTECTIVE SYSTEM FOR 110 kV BUSBARS OPERATING FROM EARTH CURRENTS IN THE SUBSTATION STRUCTURE. L.Postler.

Elekt. Stantsii, 1959, No. 6, 68-71 (June). In Russian.

Details are given of tests carried out in Czechoslovakia on a protective system for 110 kV busbars, operating from the current in the earthing circuit for substation structures. It is shown that this type of protection can be used for 110-220 kV substations. If there are several bays of busbars the protection system should be divided into sections, each connected to the earthing circuit across a current transformer. Insulation must be added for the control cables and lighting cables, etc.

Metropolitan-Vickers

621.316.925 : 621.313.3

## 5450 RECENT DEVELOPMENTS IN THE FIELD OF GENERATOR PROTECTION. L.Ferschl.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 2, 31-9 (Jan. 15, 1960). In German.

See also Abstr. 4037-8 of 1960. Deals with the following kinds of protection: differential protection making use of higher harmonics, busbar and reserve protection, the latter consisting preferably of a directive or non-directive impedance relay, protection against earth shorts of the carcass in block connections and protection against earth shorts of the carcass for the case where the generator is connected to a busbar system.

R.Neumann

621.316.925

## 5451 RECENT PRACTICES AND TRENDS IN PROTECTIVE RELAYING.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1759-79 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Power systems are divided into overlapping zones for protection purposes with back-up protection which operates should the zone protection not be effective. Almost all large alternators are protected by percentage differential relays with overcurrent relays in the earthed neutral to provide extra sensitivity. Negative sequence operated relays are used as protection against unbalanced faults. Increasing attention is being paid to loss of excitation protection for new installations. Differential relaying has also found widespread adoption for transformer protection, the present trend being towards high-speed operation whilst sudden-pressure relays have become more reliable and are being used for tripping as well as for alarm. The difficult task of protecting bus bars adequately is performed by differential relays of the voltage or multirestraint type, whilst over-current relays are becoming less popular for this purpose although they predominate in existing installations. Directional comparison carrier relaying is used predominantly for long transmission lines. Static electronic relays have been developed but are not generally accepted. The use of microwave channels as an alternative to carrier or pilot wire systems has increased.

A.S.Hay

## OVERVOLTAGE PROTECTION.

5452 H.Baatz.

Elektrizitätswirtschaft, Vol. 59, No. 3, 58-62 (Feb. 5, 1960). In German.

There is no way of avoiding overvoltages in a system and the insulation and overvoltage protection must be designed accordingly. The design of the insulation is influenced primarily by the magnitude of internal overvoltages arising from network faults or changes in the operating conditions of the network. Overvoltages to earth resulting from earth faults seldom exceed twice the line service voltage when the neutral point is not earthed and in more extensive networks where this could occur the neutral point should be earthed for other reasons. However, higher overvoltages can arise when components are disconnected. Particular examples of this phenomena are the overvoltages occurring when capacitive currents are switched out or when small inductive loads are disconnected by minimum-oil or air-blast circuit breakers. External overvoltages on transmission lines caused by lightning strokes are independent of the service voltage and effective protection is obtained only by cabling or by using earth wires, in which case a low footing resistance is essential. Very high overvoltages can occur when wooden pole lines are used and the insulation should be reduced a short distance before the line termination to safeguard station equipment. The effects of single pole flashovers can be reduced by Petersen coils and rapid reclosing. The most important problem is, however, the dimensioning and disposition of surge diverters at the station. The protective range of surge diverters depends upon the slope of the incoming wave and cables are finding increasing application as line terminations in order to flatten out the voltage wave.

A.S.Hay

621.316.932 : 621.315.62

5453 THE PROTECTION OF HIGH-VOLTAGE INSULATORS FROM POWER-ARC DAMAGE. A.E.Guile.

Proc. Instn Elect. Engrs, Paper 3289S, publ. July, 1960, 7 pp. To be republished in Vol. 108A (1961).

Summarizes the results and conclusions of an experimental investigation into the reduction of damage by power-follow-through arcs on various types of high-voltage insulators. Where normally used, protective fittings of the usual type have been tested, and suggestions have been made for modifications to the fittings so as to give greater protection. The effects of wind have been taken into account. Only 11 and 33 kV insulators have been tested, but the investigation has been designed to obtain information which can be applied to the larger units at the highest voltages. Since any application in service of these results must depend upon economic considerations, some information is included on the amount of arc damage occurring in service to high-voltage insulators, both in this country and abroad.

621.316.932

5454 TWO-STAGE ARC QUENCHING IN HIGH-VOLTAGE SWITCHING STATIONS UP TO 30 kV. F.Meyer.

Siemens-Z., Vol. 34, No. 4, 224-5 (April, 1960). In German.

The use of arc-quenching units in high-voltage switching stations up to 30 kV provides complete protection against the effect of arcing faults. In order to limit to a minimum the interruption in operation associated with the quenching of the arc, the latter can be effected in two stages. The arc-quenching units operating in the first stage short-circuit the section in which an arcing fault has developed only until the path of the arc has been deionized. The units in the second stage act as a standby for the short-circuiting of restriking arcs. Experiments have shown that in about 90% of all arc-quenching processes only stage I is called upon, and that the section affected is again ready for operation within 0.5 seconds.

621.316.933

5455 THE INTERNATIONAL STANDARDIZATION OF LIGHTNING ARRESTERS.

H.R.Armstrong, E.Beck and G.F.Lincks.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1561-5 = Pwr Apparatus Syst., No. 46 (Feb., 1960).

A comparison is presented between American (A.S.A.) standards for surge diverters and the recent I.E.C. publication 99-1. Differences in nomenclature and definitions are outlined, particularly with respect to the earthing coefficient and test wave shapes. The respective standard ratings and test specifications are compared. Attention is drawn to certain subjects of revision which are under consideration by the appropriate I.E.C. committee.

R.H.Golde

621.316.933 : 621.313.322

5456 SURGE PROTECTION OF UNIT-CONNECTED GENERATORS. K.H.Chang and T.B.Thompson.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1580-90 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

A generalized mathematical study of voltage distribution in unit-connected generators upon penetration by high-voltage surges transferred through arrester-protected transformers. Twelve practical cases are considered, involving 100, 150 and 200 MVA units, with and without bus capacitance, and at seven levels of transmission voltage from 69 to 230 kV. Electrostatic and electromagnetic transfer through the transformer are first studied using Laplace transformation, from which it is concluded that electrostatic transfer has negligible effect; the voltage distribution along the generator winding is then analysed using classical transmission line theory.

M.R.Dickson

621.316.933.1

5457 THE SPREAD IN THE FLASHOVER VOLTAGE OF ROD GAPS. P.G.Provoost, H.G.Smits and G.J.Esser.

Electrotechniek, Vol. 38, No. 12, 309-14 (June 9, 1960). In Dutch.

Large discrepancies in the results of comparative impulse tests on rod gaps, carried out in 14 European h.v. laboratories in 1955 led to an extensive investigation of the flashover characteristics of rod gaps. Clearances to extraneous structures and the general disposition of the rod gap proved important, whereas no measurable influence on the flashover characteristics was ascertained from light, irradiation, radioactivity and the circuit constants. The results with positive polarity, measured over 8 months were reproducible within a few percent. The dispersion in the European results must be attributed to differences in the disposition of the rod gaps with respect to the impulse generator, voltage divider, earthed objects, etc. Despite all precautions no reproducible results were obtained with negative polarity; no explanation for this is offered.

G.N.J.Beck

621.316.933.1

5458 THE CHARACTERISTICS OF THE TRIGATRON SPARK-GAP AT VERY HIGH VOLTAGES. T.E.Broadbent.

Proc. Instn Elect. Engrs, Congr. 364 M, publ. Feb., 1960 (Vol. 107C, 213-15, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 2083 of 1960.

621.316.935 : 621.395.73

5459 NEUTRALIZING CHOKES FOR TELEPHONE LINES ENTERING POWER STATIONS. O.Ramsaur.

Trans Amer. Inst. Elect. Engrs III, Vol. 79, 124-8 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

Differences of potential between incoming telephone circuits and power-station earthing systems can be introduced by power-line fault currents, magnetic induction from neighbouring lines, actual contact with such lines or by earth faults. For purely a.c. telephone lines, isolating transformers can and should be used to protect personnel and equipment, but for d.c. circuits of any kind it is shown that the 2-winding balanced longitudinal choke has many advantages, economic as well as technical, over either 3-winding neutralizing transformers or drainage reactors. Neon-lamp shunt circuits to ground are necessary to complete the energizing paths for the chokes. Three typical circuits are illustrated and described. A discussion is reported.

W.J.Mitchell

621.316.98

5460 ATMOSPHERIC OVERVOLTAGES IN ELECTRICAL SYSTEMS. J.A.Giaro.

Bull. Soc. Roy. Belge Elect., Vol. 76, No. 1, 1-24 (Jan.-March, 1960). In French.

The mechanism of lightning overvoltages on overhead lines is briefly discussed and it is shown how the rigorous mathematical treatment of surge reflection can be simplified for specific cases. The case is examined in detail of the voltages developed at the terminations of a cable connected to an overhead line which, in turn, is subjected to a direct stroke causing back flashover to a phase conductor. A series of graphs is developed and their application to the solution of numerical problems is illustrated. The results obtained are applied to the problem of the protection of a substation connected to an overhead line incorporating a length of cable.

R.H.Golde



- 621.316.98 : 621.315.1  
**THE SHIELDING EFFECT OF LIGHTNING ARRESTERS.**  
 5461 P.G.Provoost.

Electrotechnik, Vol. 38, No. 10, 259-67 (May 12, 1960). In Dutch.  
 A brief survey is given of earlier work on overhead earth wires, the results of model tests by various investigators being compared. Methods of calculation based on the physical effects of downstroke of the leader are examined in more detail. A table is given showing the main characteristics, including shielding angle, for metal masts of overhead line (shielding angle only, for wooden masts), subdivided according to the number of lightning faults per year per 100 circuit-miles. Lightning performance of existing o.h. lines in Germany, U.S.A., and U.S.S.R. is compared. G.N.J.Beck

621.316.96 : 551.5

- LIGHTNING AND CHARGE STORAGE.**  
 5462 E.J.Workman, M.Brook and N.Kitagawa.  
 J. geophys. Res., Vol. 65, No. 5, 1513-17 (May, 1960).

An unusual lightning flash consisting of a record 54 current surges, of which 26 were leader-return-stroke combinations, and having a total duration of 2 sec, is described. The character of the lightning flash evidences a charge configuration of large extent, thought to consist of from 4 to 6 thunderstorm cells simultaneously active. The electric and photographic evidence indicates path lengths of approximately 9 km (30 000 ft) for the final strokes of the flash.

621.316.98

- HF NOISE RADIATORS IN GROUND FLASHES OF TROPICAL LIGHTNING.** S.V.C.Aiya.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 5, 955-6 (May, 1960).

The time characteristics of typical earth flashes in a tropical country are listed and correlated with probable elements in the discharge mechanism. The h.f. radiating power in an earth flash is found to be of the same order of magnitude as in a cloud flash. A comparison is made with similar records obtained in England. R.H.Golde

621.316.98

- THE SHIELDING OF OVERHEAD LINES AGAINST LIGHTNING.** J.H.Gridley.  
 Proc. Inst. Elect. Engrs, Paper 3172 S, publ. Jan., 1960 (Vol. 107A, 325-35, Aug., 1960).

Republication, with discussion, of the paper already abstracted as Abstr. 137 of 1960.

621.316.99 : 621.317.33

- BIBLIOGRAPHY ON GROUND RESISTANCE AND POTENTIAL GRADIENT MEASUREMENTS.**  
 5465 Trans Amer. Inst. Elect. Engrs III, Vol. 79, 52-8 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

## TRACTION . DRIVES

621.332.35

- INVESTIGATIONS OF A 3-WIRE TROLLEYBUS SUPPLY SYSTEM.**  
 5466 V.E.Rozenfel'd, V.N.Popelyash and A.G.Smirnov.

Elektrichestvo, 1960, No. 3, 60-4 (March). In Russian.

Results of service trials of a contact line, so arranged that the "up"-buses were fed between the plus and earth-wire, whilst the "down"-buses were connected between the earth and negative wire, are given. In the substations two converters are connected in series and the neutral is earthed. The results of trials show a considerable reduction in the voltage drop and losses. The problem is treated mathematically, calculation being made for various lengths of line and various traffic densities, the results are tabulated. Except for a very small system, they confirm that with the 3-wire contact line reduction of losses and of the capital cost may be achieved. A.Karlsbad

621.335.2

- THE DIFFERENT METHODS OF ELECTRIC RAILWAY TRACTION USED BY THE SWISS FEDERAL RAILWAYS SINCE THEIR COMMENCEMENT.** A.Degen.

Bull. Assoc. Suisse Elect., Vol. 51, No. 12, 595-604 (June 18, 1960). In German.

An economical and historical description of the development of

electrical railway traction methods utilized by the Swiss Federal Railways. The standard system operates at 15 kV 16 2/3 c/s and the locomotives are powered by a.c. commutator motors. Reference is made to Diesel-electric, twin-power locomotives which can be powered either by batteries, Diesel engines or overhead lines. Battery-operated locomotives and electrically heated steam engines were in use. The Swiss Federal Railways wholly or partly own power houses and hydro-electric power plants and the generating capacity of the latter is discussed. The Authority also owns single phase 16 2/3 c/s transmission lines having a total length of 1300 km and are operated at 132, 66 and 33 kV running in parallel and independent of the public utilities grid system, but where necessary the two systems are interconnected by static and rotating converting stations. A short resumé is given of the German, Austrian, Italian and French electric railway systems and the operation of the border stations is described. I.Bardos

621.335.2

- TRANSIENT PHENOMENA IN THE TRACTION MOTOR CIRCUIT OF D.C. LOCOMOTIVES.** G.Seifert.

Elect. Traction Rlys (Internat. Rly Congr. Assoc.), Vol. 11, No. 3, 132-43 (March, 1960).

Deals with transient phenomena encountered in the course of switching and compensating operations in the traction motor circuits of d.c. locomotives during resistance starting, weak-field running, or braking. The systems concerned are analysed using certain simplifying assumptions and the results and effects of these phenomena on the performance of the locomotive are discussed. Empirical values and directives for the practical utilization of these results in the design and construction of d.c. locomotives are given.

621.335.2

- THE EXPRESS LOCOMOTIVE E 646 OF THE ITALIAN STATE RAILWAYS.** A.Peters.

Elekt. Bahnen, Vol. 31, No. 1, 9-11 (Jan., 1960). In German.

A brief illustrated description of this locomotive of type Bo'Bo'Bo'. Each of the three bogies is fitted with two double motors, the locomotive thus having 12 motors which may be connected in series, series-parallel (6 + 6), parallel (4 + 4 + 4) and super-parallel (3 + 3 + 3 + 3). In the first two connections there are 5 field-weakening stages and in the third connection, 3 stages. The motors are mounted with sliding bearings on a hollow shaft which carries the large gear wheel and is connected to the driving wheels by a "dancing ring". The motors have 6 poles, 6 commutating poles and a compensation winding. R.Neumann

621.335.2

- THE LIGHTWEIGHT D.C. LOCOMOTIVE FROM SERIES 9400 OF THE S.N.F.C.** A.Peters.

Elekt. Bahnen, Vol. 31, No. 1, 17-18 (Jan., 1960). In German.

A brief illustrated description of this locomotive of type B'B', weighing 60 t and suitable for 1500 V d.c. The hourly power is 2304 kW at a speed of 48.5 km/h, the continuous power 2135 kW at 50 km/h and the max. speed 130 km/h. Each bogey is fitted with one 6-pole motor with compensation winding. On the shunt stages the field may be weakened by up to 30%. The locomotive may be started not only with the motors in series connection but also in parallel connection. The starting resistors are switched off in 28 steps. R.Neumann

621.335.2

- VIRGINIAN RAILWAY MOTOR-GENERATOR ELECTRIC LOCOMOTIVE MAINTENANCE COSTS.** T.F.Perkinson.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 33-5 (1960) = Applic. and Industr., No. 47 (March, 1960).

621.335.7

- 2100 H.P. DIESEL-ELECTRIC LOCOMOTIVES SERIES 060-DA FOR THE ROUMANIAN STATE RAILWAYS.**

H.Hondius.

Elekt. Bahnen, Vol. 31, No. 3, 59-70 (March, 1960). In German.

A detailed illustrated description of these locomotives (type Co'Co') six of which were built in Switzerland and ten in Roumania. The Diesel engine is arranged centrally, easily accessible from all sides and directly coupled to a main and auxiliary generator. These supply current to the 2 x 3 nose-suspended motors arranged on the 3 axles of the 2 bogies. Two groups of ventilators supply cooling air for the driving motors. The Diesel engines are of the 12 cylinder, two-row, four-cycle type working with direct injection and running at 750 rev/min. A schematic sketch shows the regulation of the

Diesel-electric group, particularly the speed adjustment, speed and fuel control, load control and protective devices. The main generator has a rated power of 2400 kW, the auxiliary generator of 75 kW. The driving motors are laid out for a continuous load of 200 kW. Their highest speed is 2300 rev/min. The gear ratio is 1 : 4.6.

R. Neumann

621.337.2

#### 5473 TRANSIENTS IN AUTOMATIC STEP-TYPE CHRONOMETRIC CONTROL OF ELECTRIC LOCOMOTIVES.

B. P. Petrov.

Elektrichestvo, 1960, No. 1, 33-7 (Jan.). In Russian.

For the automation of step-type (non continuous) starting and braking of the traction motors of electric locomotives, time-dependent (chronometric) control is now being used. Full evaluation of the properties of this type of control is only possible in an investigation which takes into account the discontinuity in the variation of the parameters of the circuit. Some possible methods for such an investigation are described for characteristic examples. Brief details are given of calculation of the starting diagram of an electric locomotive using these methods.

Associated Electrical Industries (Manchester)

621.34

#### 5474 DEVELOPMENTS IN DRIVES FOR MODERN MANUFACTURING PLANTS. W. Ostendorf.

B.B.C. Nachr., Vol. 42, No. 6-7, 317-26 (June-July, 1960). In German.

A review of developments in the drives for large machinery, such as planing machines, paper machines, rolling-mills etc. Special reference is made to the speed regulation of d.c. machines, including the control of rectifiers. Transistor regulation of rectifiers is explained, together with digital computer devices. A bibliography with 34 references is added.

R.G. Jakeman

621.34

#### 5475 STATIC CALCULATION OF A D.C. DRIVE. S.A. Bakharev.

Elektrichestvo, 1960, No. 3, 34-7 (March). In Russian.

A method of calculating the stabilized state of a d.c. drive is explained by applying it to an example of a complicated automatic regulation system in which a motor is fed from a rotating amplifier, excited through various stages of amplification. Considering each stage as a separate circuit and taking into account its coefficient of transmission the mechanical characteristic (motor speed as a function of exciter voltage) is calculated. The method enables the determination of an overall transmission coefficient required to maintain the speed constant within the limits of an allowed "static error".

A. Karlsbad

621.34

#### 5476 TECHNOLOGICAL VIEWPOINTS WITH REGARD TO DRIVE CONTROLS IN PROCESSING PLANTS. E. Gürk.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 76, No. 23, 574-8 (Dec. 1, 1959). In German.

The present tendency in processing plants is the changeover from mechanization to automation. The work of various experts from different branches of industry has to be coordinated to achieve the desired results. Three different type of expert are involved, namely the drive technician, the technologist and the control technician. In certain cases, the field of competence of each is strictly defined, as is the case when machine speed and torque are the controlled variables. However, when some property of the product, such as paper tension in the case of a paper mill, is the controlled variable, the fields of competence overlap and numerous technical as well as managerial problems arise.

A.S. Hay

621.34

#### 5477 CALCULATING THE POWER REQUIREMENTS OF LOOM DRIVES WITH A RESILIENT COUPLING. K. Kölmel.

Siemens-Z., Vol. 33, No. 9, 562-9 (Sept., 1959). In German.

On account of the vibration produced by the sley and also the picking motion, the electric drive motors of mechanical looms are subjected to severe and rapid load fluctuations. All the resulting electrical and mechanical power phenomena are investigated and several important relationships obtained. From these it is possible to derive measures which reduce the losses of the motor. A new type of resilient coupling prevents the load fluctuations of the loom from acting on the drive motor.

621.34 : 621.316.718.5

#### 5478 ANALYSIS OF SERIES GENERATOR SERIES MOTOR DRIVE. R.W. Jones and A.U. Meyer.

Trans Amer. Inst. Elect. Engrs III, Vol. 79, 31-9 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

In its simplest form this device consists of a constant-speed series generator supplying a series motor, and this will provide a relatively constant speed over a wide load range. A mathematical analysis is developed to establish the possible types of system operation and to present the conditions for their existence.

A bibliography is added.

R.G. Jakeman

621.34 : 621.316.718

#### THE ELTOR SYSTEM FOR SYNCHRONOUS SPEED CONTROL OF SECTIONAL DRIVES ON PAPER MACHINES. See Abstr. 5431

## CONDUCTORS . RESISTORS

(See also Semiconductor Materials)

621.315.53

#### 5479 PRODUCTION OF HEAT-TREATED ALUMINIUM-ALLOY WIRES FOR CONDUCTORS. F. Balázs and T. Kiss.

Acta tech. Hungar., Vol. 28, No. 1-2, 121-31 (1960).

Experiments were carried out to investigate the effect of production methods on the quality of Aldrey-type aluminium alloy wires. The experiments proved that ageing after hardening and before cold-working has an important and advantageous effect on the quality of the material. Further investigations showed that the iron content of the alloy has a rather strong influence on the electrical resistance and less influence on the mechanical strength of the material.

621.315.56

#### 5480 THE LONG-TERM STABILITY OF FIXED RESISTORS. H.F. Church.

Proc. Instn Elect. Engrs, Paper 3277 E, publ. July, 1960 (Vol. 107 B, 377-85).

The causes of long-term failure under practical conditions of use or storage of different types of fixed resistors commonly used in electronic equipment have been investigated. Some of the life tests have proceeded without interruption for almost four years. Carbon-composition (grade 2) resistors under load fail by slow thermal degradation of the resistive material. Drift of value may also occur if unloaded resistors of this type are stored in a damp atmosphere. Vitreous-enamelled wire-wound resistors made with fine wire may fail during tropical exposure both unloaded and especially when lightly loaded with direct current. This is owing to electrochemical corrosion taking place at faults in the vitreous coating. High-stability cracked-carbon (grade 1) resistors may fail rapidly under light d.c. load by electrochemical action if moisture condensation occurs and the protective paint or varnish coating is inadequate. Tests for long-term resistor stability are critically discussed.

621.315.57

#### 5481 CONDUCTING HARD RUBBER AND ITS USE AS COMPOSITION RESISTOR. S. Mishra.

J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 2, 77-82 (Feb., 1960).

A study of the conducting characteristics of carbon-black compounded hard rubber using various types of carbon black with cured samples 38 mm. long and 7 mm. diameter is described. The effect of percentage carbon-black content, temperature of curing, period of curing and ageing of mixture on conductivity was investigated. These investigations reveal that all carbon blacks do not give stable conducting properties. It was possible to get stable conducting characteristics up to a specific resistance of 10 MΩ cm. and stable resistors 38 mm. long and 7 mm. diameter up to 100 MΩ were made. These resistors were found to have low voltage coefficient and low temperature coefficient. Details of a noise-measuring equipment are given. Noise measurements show that the noise characteristics of these resistors are better than similar resistors, especially for values below 1 MΩ.

## INSULATING MATERIALS DIELECTRICS

621.315.611 : 621.314.2

5482 **FACTORS AFFECTING THE AGING CHARACTERISTICS OF VARIOUS WIRE COATING MATERIALS IN TRANSFORMER OIL.** G.F.Lipsey and P.W.Juneau, Jr.  
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 73-7 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

Describes thermal ageing data on film-insulated round wires obtained at higher than normal temperatures in environments similar to those found in sealed oil-immersed transformers. Enamelled wires are twisted together and placed in a container with kraft paper and transformer oil inhibited with d.b.p.c. Some of the paper was not dry. Dielectric strengths of aged samples were determined under oil at a temperature of 105°C. The main test results relate to phenolic modified polyvinyl formal coated wire and it is shown that the electric strength is well maintained even after 200 days at 200°C. Tests with other materials show that the ability of the wire enamel to function satisfactorily depends on its hydrolytic stability and dielectric strength characteristics in the presence of moisture. All the enamels tested including urea-formaldehyde epoxy, acrylic and the material mentioned above all absorbed water to a greater or lesser extent and suffered a loss in dielectric strength in consequence, but the modified polyvinyl formal wire behaved much the best.

W.R.Stoker

621.315.612.6

5483 **THERMAL LIFE OF VARNISHED GLASS CLOTH.** C.J.Straka and E.W.Lindsay.  
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 58-64 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

The suggested A.S.T.M. (American Society for Testing Materials) and A.I.E.E. methods for the evaluation of the thermal stability of varnished glass fabric insulation are reviewed and the A.S.T.M. "Electric Breakdown Test Procedure" was found to be the better method, for it is more reproducible and gives a history of life of the varnish during thermal aging. The thermal stability of modified phenolic varnishes as measured by the A.S.T.M. breakdown procedure was substantiated by the thermal life evaluation of the same varnish in an insulation system by functional motor tests.

621.315.613.2

5484 **THE SIGNIFICANCE OF IRON IN ASBESTOS MATERIALS USED FOR ELECTRICAL INSULATING PURPOSES.** P.O.Nicodemus.  
A.S.T.M. Bull., No. 237, 62-7 (April, 1959).

An A.S.T.M. subcommittee concluded that there is no correlation between total iron content and electrical properties important in the use of asbestos. It is the magnetite which is definitely harmful. The "Navy method" of determining the magnetic rating (heating at 845°C and removing the magnetite with an electromagnet) gives variable, even erroneous, results. The magnetic analyser method (ASTM D 1118-57) has shortcomings but is reproducible. Randomness in particle distribution must be ensured in the test sample, since particle size and orientation affect the result.

I.D.L.Ball

## MEASURING METHODS ELECTRICAL TESTING

621.317.312/.32

5485 **DETERMINATION OF ERRORS OF PRECISION ALTERNATING-CURRENT VOLTMETERS AND AMMETERS. I. TESTING WITH FREQUENCY OF 50 c/s. II. TESTING WITH FREQUENCIES ABOVE 50 c/s.** H.Helke.  
Arch. tech. Messen, No. 288 (Ref. Z 733-13), 17-20 (Jan.); No. 289 (Ref. Z 733-14), 43-4 (Feb., 1960). In German.

Pt I reviews thermal devices which function equally on a.c. and d.c., and are therefore used in substitution methods, the ultimate reference being a standard cell. Examples are; thermocouples used with a d.c. potentiometer; bridges incorporating barretters or negative-temperature-coefficient resistors. The bridges balance at one voltage (or current) only, and can be proportioned to give an

r.m.s. reference voltage of 1 V. Bridges incorporating non-linear resistors produce waveform distortion and a phase displacement between voltage and current. The effects can be balanced out by adding capacitors and resistors to the bridge, and the error reduced to <0.01%. Pt II briefly reviews measuring apparatus for use up to 20 kc/s. For bridges, the vibration galvanometer balance detector used in 50 c/s tests is replaced by a tuned amplifier (bandwidth 2%).

C.F.Pizzey

621.317.313 : 621.314.224

5486 **TECHNIQUES FOR THE CALIBRATION OF STANDARD CURRENT TRANSFORMERS UP TO 20 kc/s.** J.J.Hill.  
Proc. Instn Elect. Engrs, Paper 3297 M, publ. Sept., 1960, 4 pp. To be republished in Vol. 108A (1961).

When standard current transformers are tested at high audio frequencies the errors and uncertainties in the measurements are liable to be great owing to the effects of stray magnetic fields on the large unshielded resistors which of necessity have to be used. The sources of stray fields are examined and means are suggested for substantially reducing them. It is shown that the 4-terminal resistance standards used in current-transformer testing bridges are very frequency-dependent and present techniques limit the accuracy of measurement at 20 kc/s to 2 parts in 10<sup>4</sup> in ratio and 0.8' in phase. New techniques are described by which the errors and uncertainties can be reduced to give an accuracy of 5 parts in 10<sup>5</sup> and 0.1' at 20 kc/s.

621.317.321 : 621.389

VECTOR-ELECTROCARDIOGRAPHY. See Abstr. 5131

621.317.321 : 621.389

COMMENTS ON MICROELECTRODES. See Abstr. 5132

621.317.329

5487 **DESIGN AND CONSTRUCTION OF THE ELECTROLYTIC TANK WITH AUTOMATIC TRACING OF EQUIPOTENTIALS AT C.F.T.H.** J.E.Picquendar and O.Cahen.  
Rev. tech. C.F.T.H., No. 32, 59-72 (Feb., 1960). In French.

Describes an electrolytic tank for the automatic plotting of equipotentials in a Laplacian field. Twenty-five four-digit figures, corresponding to wanted equipotentials, can be stored in a relay bank. Each equipotential is traced out in turn by a servo-controlled probe. Conventional automatic telephone equipment is used to carry out the programme.

T.Mulvey

621.317.33 : 621.314.2

5488 **DIELECTRIC TESTS ON TRANSFORMERS AS INFLUENCED BY FURTHER BIL REDUCTIONS.**

J.R.Meador and N.E.Dillow.  
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 99-100 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

A discussion of the effect of further reductions in basic impulse insulation levels on low-frequency and surge-voltage test requirements and on radio-influence voltage tests; a case is made for using the bushing capacitor tags in the latter tests.

M.R.Dickson

621.317.332.1

5489 **A.C. COMPENSATION CIRCUITS WITH LARGE RANGE OF [SPECIMEN] LOADING.** R.Putz.  
Arch. tech. Messen, No. 288, (Ref. J 942-1), 15-16 (Jan., 1960). In German.

The modification of a bridge circuit is described which allows the unknown impedance to be subjected to a much higher voltage than two out of the remaining three bridge components. The third one, in series with the specimen, still has to carry the load current.

K.W.Plessner

621.317.332.1 : 621.385.032.213.13 : 537.533 : 537.7

5490 **A NEW METHOD FOR THE MEASUREMENT OF CATHODE INTERFACE IMPEDANCE.** J.Tamiya.  
Rev. sci. Instrum., Vol. 31, No. 7, 696-700 (July, 1960).

A simple and sensitive bridge method for the measurement of cathode interface impedance is reported. A tube with an interface impedance under test in this method forms a bridge together with a reference tube with no interface layer and with an external variable RC circuit in its cathode return. The bridge is excited by a set of three sinusoidal signals of 200 kc/s, 1.1 and 5 Mc/s. The unknown interface impedance is then measured by simultaneously balancing the bridge for these frequencies. The detector consists of amplifiers tuned to each frequency and a c.r.o. that displays each signal



separately. A small wobbling of the transconductance in the reference tube is also provided for simplifying the measurement and overcoming drift of tube characteristics. This bridge has a sensitivity of the order of 0.002 rad as a minimum detectable phase-shift, and allows a measurement of interface resistance as low as a few ohms with time constants of 0.01  $\mu$ sec or more, even in ordinary tubes.

621.317.332.2

#### 5491 LOW-Q COIL MEASUREMENTS. R.E. Lafferty.

Electronics, Vol. 33, No. 18, 112 (April 29, 1960).

Discusses the constant impedance method of H.M. Turner (1928) where the inductance under test and a variable capacitance are connected either singly or both in parallel across a constant voltage a.c. supply. Expressions for L and Q are derived in terms of frequency and capacitance settings. A circuit is shown of a practical instrument suitable for measurement of Q from 0.1 to 10 with or without superimposed d.c. in a frequency range of 50 c/s to 10kc/s.

Z.A.A. Krajewski

621.317.333

#### 5492 A NEW METHOD OF ASSESSING THE MOISTURE CONTENT IN THE INSULATION OF ELECTRIC MACHINES. G.I. Lysakovskii.

Elekt. Stantsii, 1959, No. 6, 41-2 (June). In Russian.

The method consists in measuring  $\tan \delta$  by Schering bridge with Wagner earth between phases or circuits, so as to exclude the capacitances of the bars in the slots. Only the capacitances between the end connections of bars in one row are measured, as well as the mutual capacitances of the end connections of bars in different rows, and between the small faces of the pairs of bars of different phases (or circuits) in one slot.

Electrical Research Association

621.317.333 : 621.315.624

#### A.C. FLASHOVER VOLTAGE OF LONG INSULATOR STRINGS IN HIGH-VOLTAGE LABORATORIES AND OPEN-AIR TESTING STATIONS. See Abstr. 5402

621.317.333 : 621.313.322

#### ELECTRICAL TESTING OF THE INSULATION OF LARGE GENERATORS. See Abstr. 5350

621.317.335 : 537.7

#### 5493 A SWITCH FREE OF INSULATING MATERIAL.

U.Kimmel and D. Palme.

Exper. Tech. der Phys., Vol. 8, No. 1, 37-9 (1960). In German.

The object of the device described was to connect the crystal under test either to a source of voltage or to an electrometer, without having any other insulating support in parallel with the crystal. The device uses magnets to support the conductor and to achieve the change-over operation.

K.W. Plessner

621.317.335 : 621.318.42

#### 5494 MEASUREMENT OF THE SELF-CAPACITANCE OF INDUCTANCE COILS. P. Todorov.

Nachrichtentechnik, Vol. 9, No. 9, 427-9 (Sept., 1959). In German.

In measuring by the resonance method the self-capacitance of a coil, using a two-pole three-element circuit with a variable capacitor for tuning, it is shown that the method employing a series resonant circuit has the following advantages over the commonly used parallel resonant circuit: (1) the internal impedance of the generator, the input impedance of the resonance indicator and the stray capacitances of the circuit have no effect on the measurement; (2) the effect of coil resistance is less with the series resonant circuit and permits a more accurate measurement on coils of low Q-factor.

C.F. Pizzey

621.317.335.3 : 621.315.612

#### 5495 DETERMINATION OF THE DIELECTRIC PROPERTIES OF LOW-LOSS CERAMICS AT Q-BAND FREQUENCIES.

J.M. Free and G.B. Walker.

Proc. Instn. Elect. Engrs, Paper 3223 M, publ. July, 1960 (Vol. 107B, 354-6).

Although the difficulties involved in the measurement of dielectric properties increase with frequency, a conventional cavity method with minor modifications has proved satisfactory at millimetre wavelengths. A cavity,  $\frac{1}{2}$  in. in diameter, was excited in an  $H_{01}$  mode by means of coupling holes. It was found to have sufficiently low wall loss to enable the loss tangents of disk specimens of magnesium titanate and titanium-dioxide ceramics to be measured. Both loss

tangents were of the order of 0.0003, and the relative permittivities were 14 and 80, respectively. Although a high degree of accuracy is not claimed, useful results can be obtained with relatively simple equipment. A convenient method of marking small frequency intervals is described.

621.317.34 : 621.395.3

#### 5496 MEASURING METHODS FOR TELEPHONE INSTALLATIONS. O. Hörner and W. Langsdorff.

Siemens - Z., Vol. 33, No. 10, 634-9 (Oct., 1959). In German.

Research, development, quality control and acceptance tests call for different measuring methods for arriving at an overall appraisal (intelligibility, repetition rate, transmission equivalent, equivalent articulation loss, quality of connection) or determining certain characteristics (crosstalk, distortion noise, etc.). The various methods, some subjective, others objective, and their spheres of application are described in so far as they are not already commonplace in transmission engineering.

621.317.34 : 621.397.6

#### 5497 NOISE LEVEL MEASUREMENT IN TELEVISION.

L.E. Weaver.

Wireless Wld, Vol. 66, No. 6, 264-6 (June, 1960).

A method particularly applicable to noise measurement of camera tubes. It is based on the fact that the energy of a television signal is almost entirely concentrated in the immediate neighbourhood of each line-frequency harmonic in the form of a rapidly decreasing series of sidebands originating from synchronizing and picture signals. The video signal under investigation is applied via an attenuator to the input of a communications receiver covering the video band down to 60 kc/s and feeding into an output meter. The receiver bandwidth is set to, say, 6 kc/s and the tuning is then adjusted until the setting is midway between two output maxima (corresponding to two line-frequency harmonics). The noise power for the 6 kc/s bandwidth is then determined by calibrating the receiver and its meter with a white-noise source of known output power.

H.G.M. Spratt

621.317.34 : 621.396.62

#### TEST AND MAINTENANCE MEASUREMENTS ON THE MILAN- ROME-PALERMO TELEVISION LINK. See Abstr. 5191

621.317.34 : 621.396.62

#### RESULTS OF TESTS OF MULTICHANNEL TELEPHONIC RADIO LINKS. See Abstr. 5190

621.317.373 : 621.391.812.62

#### 5498 PHASE-MEASURING EQUIPMENT FOR V.L.F. PROPAGATION INVESTIGATIONS.

G.E. Ashwell and C.S. Fowler.

Electronic Technol., Vol. 37, No. 7, 252-5 (July, 1960).

The equipment described was developed to investigate the phase difference between the signals from a single very low-frequency (v.l.f.) transmitter received at two sites simultaneously. A reference frequency at each site was derived from the pulse-recurrence frequency of the transmissions from stations of the Gee navigational system and, by using it to change the frequency of the received v.l.f. signal, an audio-frequency signal was obtained which had the phase characteristics of the v.l.f. signal. The a.f. signal from one station was passed over a telephone line to the other station where the phase difference was measured between it and the local a.f. produced in an identical manner. The long-term accuracy of measurement was  $\pm 2^\circ$  of phase in the frequency range 15-20 kc/s and the short-term accuracy, for periods up to 30 minutes, was better than  $\pm 1^\circ$  of phase. One station was designed to be mobile and satisfactory operation of the system was obtained with receiver separations up to 400 km.

621.317.38 : 621.373.44

#### NORMAL PULSE GENERATOR AND SET FOR MEASURING OF SHORT TIME INTERVALS. See Abstr. 4970

621.317.382

#### 5499 AUTOMATIC ELECTRONIC MEASUREMENT OF ELECTRICAL POWER BY MEANS OF A HALL GENERATOR. G. Rehm.

Arch. tech. Messen, No. 290 (Ref. J 86-5), 61-4 (March, 1960). In German.

The Hall effect in germanium is used to control and measure electrical power using transistor amplifiers controlled by a photoconductive cell illuminated by the light from a galvanometer having its deflection proportional to the voltage produced across the Hall cell. The output from the amplifier is also transmitted as a telemetering signal.

A.C. Whiffin

- 621.317.39  
5500 MEASUREMENTS WITH RESISTANCE STRAIN GAUGES ON RAILWAY AXLES WHILE TRAVELLING AT 90 km/h. W. Zottmann and F. Schubert. Arch. tech. Messen, No. 288 (Ref. V. 8291-5), 9-10 (Jan., 1960). In German.

Rosette networks of electrical resistance strain gauges are attached to the axle in the conventional manner and are connected with the recording apparatus by a specially constructed set of slip rings. Static calibration is employed and the instruments are used to record torsion and bending. A.C. Whiffin

- 621.317.39 : 534.83  
5501 APPARATUS FOR THE INTEGRATION OF ACOUSTIC INTENSITY. APPLICATION TO THE MEASUREMENT OF NOISE FROM MACHINES. P. Baron. Acustica, Vol. 6, No. 5, 412-20 (1956). In French.

A technique is described for the measurement of total acoustic power radiated by a source. The output from a microphone traversing in a short time a path in a known surface near a source, heats an insulated block of copper. The final temperature rise can be related to the radiated sound power. A few results for the sound from electric motors are given. H.D. Parbrook

- 621.317.39  
5502 APPLICATION OF THERMISTORS IN TEMPERATURE MEASUREMENT. V.S. Senin. Priborostroyeniye, 1959, No. 9. In Russian. English translation in: Instrum. Constr., 1959, No. 9, 16-18 (Sept.).

A simple circuit having a linear resistance-temperature characteristic and incorporating only two resistors and one thermistor is discussed. The construction and electrical design of a temperature-sensitive element employing this circuit and used to measure liquid temperatures in the range  $-20^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  is described in detail. It is claimed that the error never exceeds  $\pm 0.5^{\circ}\text{C}$  and that the element responds to a  $90^{\circ}\text{C}$  change in the temperature in 0.5 seconds. T.R. Foord

- 621.317.39  
5503 SOME PROBLEMS OF MAGNETIC FLOW MEASUREMENT. I.C. Hutcheon. Instrum. Engr, Vol. 3, No. 1, 1-6 (April, 1960).

Fluid flows through a pipe perpendicular to a magnetic field  $H$ . An e.m.f.  $E$  is set up perpendicular both to the field  $H$  and flow velocity  $v$  whose magnitude is directly proportional to the product  $Hv$ . A servo-operated null-balance method is used in practice to measure  $v$  and hence the flow. The main source of error is a quadrature component in the signal picked up from the e.m.f. electrodes due to stray capacitance effects and the half turn formed by the two pick-up leads linked by the field  $H$ . The reference voltage is formed by passing the current causing  $H$  through a motor-driven slide wire. The quadrature e.m.f. component is suppressed by demodulating any residual quadrature component at the output of the main amplifier, smoothing and remodulating in such a way that when fed back to the amplifier input it cancels the original signal. This method involves the use of a precise quadrature supply and this is obtained from a thermistor bridge. (Abstr. 349 of 1960). J. MacCormack

- 621.317.39  
5504 THE HYDROGEN QUARTECTOR — A NEW PHASE DETECTOR FOR EXOTIC LIQUID-GAS SYSTEMS. R.L. Blanchard and A.E. Sherburne. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 779-86 (April, 1960).

The problem of an instrument to discriminate automatically between liquid and gaseous hydrogen has been solved. The principle of operation involves the dependence of acoustic radiation resistance upon density of the medium. The instrument comprises a quartz piezoelectric vibrator immersed in the medium and developing at its terminals a radiation resistance, and an electronic unit external to the medium, which automatically converts this resistance to a signal for measurement or control. The system is suitable for use with most fluids, including hydrogen, oxygen, and kerosene. Hydrogen is of particular interest because low density provides a less distinct interface, particularly at high pressure. The radiation resistance of practicable sensor configurations is analysed for a number of fluids and experimental data are presented for conditions of liquid, gas, and wet in gas. An electronic technique for precise conversion of radiation resistance to a control signal is described. A stable negative resistance is generated, and maintenance of oscillation is the criterion for radiation resistance greater or less than the prescribed value of negative resistance. This negative resistance is

chosen to be intermediate in value between the values which obtain for liquid and gas phases. Stable radiation resistance resolution of a few per cent has been obtained easily without encountering any limiting condition. An example of equipment designed for missile environmental conditions is described.

- 621.317.39 : 532.5  
5505 AN INSTRUMENT FOR MEASURING LIQUID LEVEL AND SLOSH IN THE TANKS OF A LIQUID-PROPELLANT ROCKET. L.B. Wilner, W.L. Morrison and A.E. Brown. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 786-8 (April, 1960).

A measuring system for monitoring dynamic level variations in red fuming nitric acid is discussed. The system employs a continuous variable-capacitance sensor with a tuned-circuit capacitance detector. The transistorized, temperature-stabilized capacitance detector is described in detail. Performance data are presented.

- 621.317.39 : 621.165  
5506 NEW INSTRUMENT SYSTEMS FOR RECORDING TURBINE SPEED, ECCENTRICITY, EXPANSION AND VIBRATION. H.A. Harriman and D.M. Longenecker. Trans. Amer. Inst. Elect. Engrs III, Vol. 78, 1626-34 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

A description is given of a complete instrument system for use during tests on turbines which also incorporates controls for shutting down the plant in the event of the magnitude of one of the components exceeding a predetermined level. Shaft eccentricity is measured by a pair of coils placed  $\frac{1}{16}$  in. from the shaft and fed at 415 c/s from a generator, relative movement of the shaft causing amplitude modulation of the carrier. The output of the network is rectified and fed to a pen recorder. Similar detectors are used to record expansion, while velocity-type pick-ups are used to measure vibrations. The signals from all of the instruments are fed to multi-channel self-balancing potentiometer recorders, sampling switches being used where necessary. A.C. Whiffin

- 621.317.39  
5507 A SIMPLIFIED RADIO-ISOTOPE THICKNESS GAUGE. E. Klar and K.H. Ihle. Nachrichtentechnik, Vol. 9, No. 12, 543-6 (Dec., 1959). In German.

Two ionization chambers, one of which is shielded from the source by the material to be measured, give a difference current which is applied to a "chopper" amplifier followed by phase sensitive detector. A large amount of negative feed-back ensures constancy of calibration and with a 10 mC Tl204  $\beta$  source, 0.15 mm Al foil can be measured readily to 1% accuracy. The instrument which is inexpensive, almost equals the vibrating reed for sensitivity and zero stability. F.T. Farmer

- 621.317.39  
5508 MEASUREMENT TRANSDUCERS WITH STANDARDIZED SIGNAL. E.M. Dushin and A.V. Fremke. Priborostroyeniye, 1959, No. 8. In Russian. English translation in: Instrum. Constr., 1959, No. 8, 7-11 (Aug.).

A general consideration of the types of transducers suitable for dealing with the signal from the primary sensing devices in automatic processes where the input and output are standardized. General design criteria are considered. Some examples of such arrangements are shown. T. Horrocks

- 621.317.39  
5509 THEORETICAL INVESTIGATIONS OF COMPLEX APPARENT RESISTANCE OF MAGNETOSTRICTIVE TOROID TRANSDUCERS. A. Fraude. Arch. Elektrotech. (Berlin), Vol. 44, No. 7, 399-418 (1959). In German.

The differential equation of forced elastic vibration of a toroid is derived from the magnetostriction and elastic equations, plane stresses being assumed. This differential equation is solved with the aid of the Green function, the solution being expressed as a series of eigenfunctions. The apparent impedance appears as a series expression involving the fundamental oscillation and the harmonics. The special case of the fundamental oscillation in a thin toroid reduces to the formula which had been derived previously. As the axial vibrations which arise from orthogonal constructions are not considered in the calculation the latter does not describe the velocity of sound or the eigenvalues exactly. This in turn can give rise to differences between theoretical and experimental values of the apparent impedance. An estimate of this difference is given for six toroids of different thicknesses. R. Parker

621.317.39  
 5510 THE CHAIN MATRIX AND SUBSTITUTION SCHEME FOR AN ELECTROMECHANICAL TRANSDUCER OF THE ELECTROMAGNETIC TYPE. A.Ya.Mel'nikhuk. Avtomat. i Telemekh., Vol. 20, No. 1, 79-84 (1959). In Russian.

Various arrangements of electromechanical transducer are expressed in terms of chain matrices. These may be in turn converted into equivalent four-pole networks. The effect of "negative stiffness" in various arrangements is considered. T.Horrockes

621.317.39 : 621.389  
 ELECTRONIC MEASUREMENT OF PARTICLE SIZE. See Abstr. 5133

621.317.39 : 621.389  
 MEASURING RADIATION WITHIN THE HUMAN BODY. See Abstr. 5135

621.317.44 : 538  
 5511 SENSITIVE FLUX MEASUREMENT OF THIN MAGNETIC FILMS. H.J.Oguey. Rev. sci. Instrum., Vol. 31, No. 7, 701-9 (July, 1960).

The two main difficulties encountered in the design of a sensitive hysteresis loop tracer for thin magnetic films are the flux calibration and the reduction of noise. The study of the flux distribution around a thin magnetic film specimen permits determination of the merits of various pickup coil configurations, as well as the form which optimizes the signal-to-noise ratio. The various disturbing voltages and the ways to eliminate them are examined. Optimization of the amplifier noise figure, proper choice of the integration network, d.c. restoration, and hum synchronization are described for the reduction of the output noise after integration and amplification. Two instruments built according to these principles are outlined. The first has a single wire pickup and is well suited for measurement of the flux distribution around a thin magnetic film and for experiments in vacuum at elevated temperatures; the second is more flexible and sensitive. By using different pickup coils covering a frequency range from 50 c/s to 10 kc/s its sensitivity is sufficient to measure flux values of  $2 \times 10^{-12}$  V/s at a frequency of 500 c/s.

621.317.444  
 5512 AN ELECTRONIC FLUXMETER. M.A.Thomae and G.F.Oerley. Rev. Electroec., Vol. 45, No. 12, 461-7 (Dec., 1959). In Spanish. Describes equipment designed for measurement of magnetic field distribution in the synchro-cyclotron at Buenos Aires. No new principle is claimed and the instrument is based on ones previously described in the literature on this subject. V.G.Welsby

621.317.61 : 621.382.333  
 THE MEASUREMENT OF SINGLE ELEMENTS OF THE TRANSISTOR EQUIVALENT CIRCUIT. See Abstr. 5068

## INSTRUMENTS MEASURING APPARATUS

621.317.7  
 5513 THE USE OF MOLDED ACTIVATED CARBON GETTERS IN SEALED ELECTRICAL INSTRUMENTS. J.R.Laskie. A.S.T.M. Bull., No. 241, 41 (Oct., 1959).

A cause of failure of contacts in sealed instruments has been shown to be due to contamination of the contact surfaces by volatile vapours given off by insulating and other constructional materials. The application of an adsorbent getter composed of a moulded, resin-bonded, activated carbon in block form for removing the vapours is described. The suggested amount of getter is 0.6 g for each 5 in<sup>3</sup> of total instrument volume. C.F.Pizzey

621.317.7  
 5514 TESTING APPARATUS FOR CHECKING HIGH-RESISTANCE AND SEMICONDUCTOR ELEMENTS. W.Wisch. Nachrichtentechnik, Vol. 9, No. 12, 546-9 (Dec., 1959). In German.

Two types of apparatus are described. The first is for measuring the voltage effect on resistors, in particular, illuminated

CdS cells. It consists of a Wheatstone bridge with a deflectional unbalance indicator (light-beam galvanometer,  $R = 150\Omega$ , sensitivity  $2.4 \times 10^{-8}$  A/scale division/calibrated -30-0-+30% change of resistance. The voltage applied to the cell or resistor under test is adjustable between 10 mV and 100 V in 17 logarithmically graded steps by applying to the bridge a voltage adjustable between 20 mV and 200 V, and proportioning the bridge so that half the voltage appears across the cell. The readings of the change-of-resistance indicator are rendered independent of the voltage applied to the bridge by switching progressively into its circuit shunts and series resistors as the voltage is raised. The second type of apparatus described is for investigating the changes in resistance of CdS cells when irradiated with hard  $\gamma$ -rays which are derived from a  $\text{Co}^{60}$  source. Six cells are disposed round the source, and their photocurrents recorded on a six-colour chopper-bar recorder. The voltage applied to the cells is adjustable between 1 and 250 V. A chopper-type d.c. amplifier is interposed between the cell circuits and the recorder. C.F.Pizzey

621.317.7 : 621.52 : 539.1.07 : 539.17  
 5515 INSTRUMENTATION FOR A SUBCRITICAL HOMOGENEOUS SUSPENSION REACTOR.

- I. REASONS BEHIND THE CHOICE OF A HOMOGENEOUS SUSPENSION REACTOR. J.J.Went.
  - II. MEASUREMENT AND CONTROL OF OPERATING PARAMETERS. B.L.A.Van der Schee and M.van Tol.
  - III. THE MONITORING OF LOW NEUTRON FLUX BY MEANS OF FAST PULSE-COUNTING CHANNELS. J.J.van Zolingen.
  - IIIb. THE MONITORING OF HIGH NEUTRON FLUX WITH THE AID OF AN ELECTROMETER. M.van Tol.
  - IV. THE SAFETY CIRCUITS. F.J.Schijff.
- Philips tech. Rev., Vol. 21, No. 4-5, 109-21, 121-33, 134-44, 144-7, 148-53 (1959-60).

621.317.71 : 537.3  
 5516 SENSITIVE AND SIMPLE INTEGRATOR. J.P.Funk. J. sci. Instrum., Vol. 37, No. 8, 276-8 (Aug., 1960).

A sensitive and simple battery-operated current integrator is described. It uses as sensing element a standard millivoltmeter or microammeter, the pointer position of which is sampled at regular intervals by electromechanical means, the required movement of a feeler then being converted into rotation of a counter. The integrator accepts signals of varying polarity and also indicates the extreme signal level during any chosen period. It is particularly suited for the integration of quantities such as daily totals of net or global radiation.

621.317.71 : 537.7  
 5517 A METHOD OF MEASURING AND RECORDING EXTREMELY SMALL CURRENTS. L.L.Dekabrun. Zh. tekh. Fiz., Vol. 27, No. 7, 1578-83 (July, 1957). In Russian. Currents in the range  $10^{-14}$ - $10^{-18}$  A are measured with an accuracy of about 10%. Elementary charges are counted, integrated and stored in an automatic recurrent cycle of up to 1 sec duration. The measured current is separated from noise background by chopping and filtering. The working cycle is timed by synchronous motor and relays. Full circuit details are given of the electronic part of the instrument, which includes an electron multiplier tube and 21 common valve types. F.Quelon

621.317.723 : 537.7  
 5518 PORTABLE ELECTROMETER VOLTMETER. W.E.K.Gibbs. J. sci. Instrum., Vol. 37, No. 8, 296 (Aug., 1960).

A high impedance d.c. voltmeter is described for measuring voltages up to 2 V of up to  $10^{10}$  ohms. The accuracy attained is about 2% of full-scale deflection and the short-term zero drift is also of this order.

621.317.723 : 537.7  
 5519 HIGH-SPEED ELECTROMETERS FOR ROCKET AND SATELLITE EXPERIMENTS. J.Praglin and W.A.Nichols. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 771-9 (April, 1960). Highly stable micromicroammeters capable of measuring currents as low as  $5 \times 10^{-14}$  A with a frequency response of at least 30 c/s can be realized using d.-c. electrometers. The circuit can be packaged in approximately 9 in<sup>3</sup> and requires less than 100 mW. An analysis of the speed of response and signal-to-noise ratio is given and expressions are derived to show the theoretical



possibilities of the method and to serve as design guides for realization of the maximum possible performance. Several practical circuits are shown and a summary is presented of the number of circuits which have been used in rocket and satellite exploration.

621.317.73  
 5520 RESISTIVITY MONITOR TO INDICATE OXIDE CONTENT OF SODIUM. L.R.Blake.

Proc. Instn Elect. Engrs, Paper 3278 M, publ. Aug., 1960. (Vol. 107A, 383-94).

The electrical resistivity of sodium or sodium-potassium is continuously measured whilst flowing at operating temperature in a pipe, to provide an indication of impurity level, particularly oxygen, and thus to enable progress of clean-up in liquid-metal loops to be followed and to give assurance that high purity is achieved and maintained. The meter is designed to be sensitive to a change of one part in  $10^6$  in oxygen level corresponding to a change in resistivity of about one part in  $10^4$ . A change in liquid-metal temperature of only  $0.04^\circ\text{C}$  will also produce this effect, and hence temperature compensation and achieving high stability are the chief problems of the design. Two types of resistivity meter are described, both of which have been installed in the Dounreay fast reactor. Tests indicate that the design objective has been achieved and the value of the meter as an impurity monitor has been proved.

621.317.733 : 537.7  
 5521 IMPROVED SQUARE WAVE INDUCTANCE BRIDGE. B.Howland.

Rev. sci. Instrum., Vol. 31, No. 7, 763-8 (July, 1960).

An a.c. bridge, useful for comparing an inductance coil with its dual equivalent circuit so as to determine, with one square wave null measurement, the values of the inductance, the equivalent series and shunt resistances, and the distributed capacitance, is described. This circuit, which features a wideband transformer of novel but simple construction, has the important advantage that one terminal of both the inductor and its dual circuit are at ground potential. Shielding problems are thereby minimized, and laboratory type decade boxes and precision variable condensers may be used to synthesize the dual equivalent circuit or to adjust the distributed capacitance of the inductor. A prototype bridge circuit, operating in the frequency range 0.1 to 350 kc/s, and incorporating compensation for errors due to residual elements is given, together with a simple alignment procedure and the results of a sample measurement of a standard inductor. It is shown that the frequency limitations of the present bridge circuit are not fundamental; an improved high frequency compensation scheme using the concept of the distributed transformer should permit operation in the v.h.f. range. The resulting transmission line bridge circuit may also have application as a precision wide band pulse reflectometer.

621.317.74 : 621.395.61 : 534.6  
 HIGH-INTENSITY SOUND REVERBERATION CHAMBER AND LOUDSPEAKER NOISE GENERATOR. See Abstr. 5187

621.317.75  
 5522 A VOLTAGE WAVE ANALYSER.

R.Dehors and G.Ségulier.

C.R. Acad. Sci (Paris), Vol. 250, No. 21, 3464-6 (May 23, 1960). In French.

The voltage (V) to be analysed is applied in series with a moving-coil milliammeter and a resistor across one diagonal of a bridge rectifier, the diagonal being that to which the a.c. supply would normally be applied. A pulse generator is connected across the other bridge diagonal to which it applies very short (duration 1%) unidirectional pulses of the same frequency as voltage V. The pulses render the bridge, which is biased so that it is normally non-conductive, momentarily conductive to V, and the deflection of the milliammeter is practically proportional to the mean value of the voltage V during the pulse. The pulse generator is controlled by a calibrated phase-shifter so that the point on the voltage wave V at which the bridge becomes conductive can be continuously varied. By connecting a potentiometer recorder in place of the milliammeter, and rotating the phase-shifter control at a constant low speed, a trace of the waveform is obtained automatically. The pulse generator incorporates three thyatrons, and the rectifiers used in the bridge are of the Si type with a reverse resistance of  $\sim 100\text{ M}\Omega$ .

C.F.Pizey

621.317.75  
 5523 OSCILLOGRAPHY WITH THE HELP OF VOLTAGE

DIVIDERS ARRANGED IN H-FORM. A.M.Ryvkin.

Elektrichestvo, 1960, No. 1, 86-8 (Jan.). In Russian.

Offers a solution to the difficult problem of oscillograph measurement between two points at high potential above earth. Measurement is achieved by using voltage dividers in the form of an H. The problems associated with this arrangement are investigated. Each arm of the H-form consists of a resistance-capacity network and it is important that correct relationship between components is maintained if true reproduction of the input is to be achieved. The network can be extended to three dividers for measuring three-phase voltages. Experiments were made between a 110-kV a.c. system and a rectified 180 and a 60-kV system fed from the same source. Oscillograms are shown obtained between various points of this system.

J.S.Wilson

621.317.755  
 5524 EMPLOYMENT OF ELECTRONIC MULTI-CHANNEL MEASURING TECHNIQUES TO RECORD PRESSURE AND TEMPERATURE IN MEDIA FLOWING THROUGH A THROTTLE TUBE. L.Narjes.

Arch. tech. Messen, No. 288 (Ref. V 8231-5), 7-8, (Jan.); No. 290 (Ref. V 8231-6), 49-52 (March, 1960). In German.

The temperatures are measured by thermocouples and the pressures by networks of resistance strain gauges fed by direct current. The output of each transducer is taken to a rotary switch having its selecting arm connected with an amplifier and hence with the y plates of an oscilloscope. The cathode ray spot is moved in the x direction by a voltage derived from a potentiometer also driven by the rotary arm of the selector switch. The image seen on the c.r.t. in a single sweep, therefore, thus consists of a number of separate vertical functions, the amplitude of each corresponding with the temperature or pressure at the corresponding measuring point. The trace also shows a base line corresponding with zero potential. It is claimed that all of 10 thermocouples and 10 pressure transducers record in 2 sec by this technique and the display is photographically recorded.

A.C.Whiffin

621.317.755  
 5525 SIMPLE STROBOSCOPIC OSCILLOSCOPE FOR DISPLAYING PULSES WITH SHORT RISE TIMES AND HIGH REPETITION FREQUENCIES.

Electronic Applic., Vol. 19, No. 3, 115-20 (1958-59).

Outlines the general theory of the stroboscopic or "sampling" oscilloscope. The response of the oscilloscope is investigated for a sampling frequency which is a subharmonic or harmonic of the input signal. A simple sampling device with high repetition frequency, equipped with the E 80 T beam deflection tube, is discussed in detail, including the influence of asymmetry in this tube. Finally, details are given of an experimental sampling device with a repetition frequency of 4 Mc/s and a bandwidth of 400 Mc/s.

621.317.755 : 538.56  
 5526 SOME MODIFICATIONS TO AN OSCILLOSCOPE CAMERA, AND THE CONSTRUCTION OF A CONTROL UNIT. M.H.Evans and G.Pierson.

J. sci. Instrum., Vol. 37, No. 8, 282-4 (Aug., 1960).

A Langham-Thompson series 200 camera has been modified to provide facilities for printing frame numbers along the edge of the photographic film, and to give warning when the supply of film is exhausted. The camera is used in conjunction with a control circuit that can provide either fully automatic operation or photography of single sweeps that have been preselected manually.

621.317.755 : 621.373.44  
 OSCILLOSCOPE FOR SPARK-GAP BREAKDOWN-TIME AND PULSE-DURATION MEASUREMENT. See Abstr.4971

621.317.772 : 537.7  
 RATIOMETER PHASE ANGLE INDICATOR.

5527 K.L.Morpheo.

J. sci. Instrum., Vol. 37, No. 8, 300-2 (Aug., 1960).

The principle of the moving coil ratiometer is described together with the circuit used with it for phase-angle measurement. The mode of operation, performance, adjustment, and calibration are given.

621.317.79 : 621.396.96  
 5528 A RADAR RADIATION MONITOR. J.M.Cottingham.

Brit. Commun. and Electronics, Vol. 7, No. 6, 419 (June, 1960).

Discusses the possible dangers to human life from radar radiations and describes a portable radiation monitor consisting of matching input, detector, amplifier, and meter, capable of detecting

a few microwatts per  $\text{cm}^2$ . By reducing the sensitivity it may be used in the  $10\text{mW}/\text{cm}^2$  region which is the significant level for human safety.

C.A.Hogarth

621.317.794

# A TRANSISTORIZED RADIATION MONITOR.

M.van Tol and F.Bregman.

Philips tech. Rev., Vol. 21, No. 7, 201-6 (1959-60).

A circuit designed so that readings are insensitive to transistor characteristics (which may shift considerably with changes of temperature) is described. A method of arriving at a (non-linear) scale that covers the whole range between zero radiation (zero deflection) and an infinitely high radiation level (full-scale deflection) is discussed. Readings are sufficiently accurate (less than 10% error for a deflection error equivalent to 1% of scale length) over a part of the scale extending from 0.1 to 0.9 of the scale length. The radiation-level reading at the upper limit of this range is 40 times higher than that at the lower limit. The instrument can easily be adjusted to bring any given radiation level within the usable range. The calibration procedure is particularly straightforward.

621.317.794 : 621.387.424 : 525 : 539.1.07

# RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES. C.S.Josias.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 735-43 (April, 1960).

One of the devices carried aboard lunar payloads, Pioneer III and Pioneer IV, was a radiation measurement instrument. Its purpose was to detect and process information on particle flux rates encountered along the nominal cis-lunar trajectory to be followed by those payloads. Radiation data were collected by two different Geiger-Mueller tubes. One tube registered particle counts and the resultant accumulation was stored in a 17-stage scaler. The other tube provided average pulse current that was a compressed function of the counting rate. This current was fed to a resistor and the voltage thus formed was transferred to a telemetering subcarrier oscillator by way of a stable d.c. amplifier. The equipment is described in three groups: (1) d.c. amplifier for the analogue experiment; (2) high-voltage circuitry for the detectors; (3) digital circuitry for the counting experiment. Details of the encoding system, which permits a large dynamic range of counting rates to be clearly presented on a single subcarrier, are also discussed.

621.317.794 : 621.387.4 : 539.1.07

# LARGE AREA GERMANIUM SURFACE-BARRIER COUNTERS.

F.J.Walter, J.W.T.Dabbs and L.D.Roberts.

Rev. sci. Instrum., Vol. 31, No. 7, 756-62 (July, 1960).

A description is given of a solid-state counter of good resolution long term stability, and fast rise time which is suitable for heavy charged particles, for example, alpha particles and fission fragments. A simple theoretical model for the counter behaviour is presented which is found to describe the observed behaviour of the counter very well. The importance of germanium purity in connection with pulse height, rise time, and counter area is discussed. Counters with sensitive areas up to  $5\text{ cm}^2$  have been successfully used.

## MAGNETIC DEVICES AND MATERIALS

621.318.132 : 621.374.32

# THE MAGNETIC EXCITATION INSIDE A CYLINDRICAL THIN-FILM FERROMAGNET. T.H.O'Dell.

Proc. Instn Elect. Engrs Monogr. 396 M, publ. Sept., 1960, 4 pp. To be republished in Part C.

An expression for the magnetic excitation inside a cylindrical thin-film ferromagnet is derived, and a Table of computed values is given. The results are considered to be relevant to work on thin ferromagnetic films for digital-storage applications.

621.318.132

# EDDY-CURRENT EFFECTS IN RECTANGULAR FERROMAGNETIC RODS. E.W.Lee.

Proc. Instn Elect. Engrs Monogr. 371M, publ. April, 1960 (Vol. 107C, 257-64, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3465 of 1960.

# THE TEMPERATURE AND FREQUENCY DEPENDENCE OF THE FARADAY EFFECT FOR MILLIMETRE WAVELENGTHS. D.I.Mash.

Zh. tekh. Fiz., Vol. 28, No. 12, 2713-15 (Dec., 1958). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 3, No. 12, 2483-5 (Dec., 1958).

The advantages of Faraday rotation devices as microwave isolators and modulators are discussed. Measurements made of the frequency and temperature dependence of Faraday rotation and insertion loss made on four kinds of ferrites — NTs-500, B-1000, F-600 (the compositions of which are not mentioned) and NiAl — over the temperature range from room temperature to  $180^\circ\text{C}$  and in the 8 mm wavelength region are reported and discussed. The apparatus used is described briefly.

S.A.Abern

621.318.23 : 538.1

# PERMANENT MAGNETS OBTAINED BY DRAWING COMPACTS OF PARALLEL IRON WIRES. F.P.Levi.

J. appl. Phys., Vol. 31, No. 8, 1469-71 (Aug., 1960).

The method consists of drawing a compact containing parallel iron wires spaced by a copper alloy matrix until the iron wires become extremely small. Intrinsic coercive forces of 400 Oe have been measured in samples drawn from compacts in which the initial spacing between the iron wires corresponded to an iron packing fraction  $p$  of about 0.45. Annealing of cold drawn samples generally increased both the coercive force and the squareness of the demagnetizing curve.

621.318.381 : 621.384.612.11

# THE SUPPLY SYSTEM FOR THE SYNCHROPHASOTRON ELECTROMAGNET AT THE CONSOLIDATED NUCLEAR RESEARCH INSTITUTE.

M.A.Gashev, E.G.Komar, A.Monoszon, F.M.Spevakova and A.M.Stolov.

Elektrichestvo, 1960, No. 1, 6-10 (Jan.). In Russian.

This synchrophasotron is capable of accelerating protons up to  $10^{10}\text{ eV}$ . One of the most important problems in the design of this equipment was the development of the supply for the electromagnet, which has the following rated supply: maximum output 140 MW, maximum current 12.8 kA, maximum voltage 11 kV, energy stored in magnetic field  $148 \times 10^4\text{ J}$ , losses in winding of electromagnet 4 MW. The power circuits, converter valves, valve control system, demagnetization apparatus, and protection system, are described.

Associated Electrical Industries (Manchester)

## INDUCTORS . REACTORS RELAYS

621.318.4

# EXTENSION OF THE DUAL-INPUT DESCRIBING-FUNCTION TECHNIQUE TO SYSTEMS CONTAINING REACTIVE NON-LINEARITY. R.M.Huey, O.Pawloff and T.Glucharoff.

Proc. Instn Elect. Engrs Monogr. 383 publ. June, 1960 (Vol. 107C, 334-41, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3472 of 1960.

621.318.435.3 : 621.34

# TRANSDUCTOR-CONTROLLED D.C. DRIVE FOR 25 kW OUTPUT POWER. See Abstr. 4768

621.318.435.3 : 621.359.4 : 621.319.5

# APPLICATION OF TRANSDUCTORS TO ELECTROSTATIC FILTER INSTALLATIONS. See Abstr. 4883

621.318.5

# HIGH-SPEED NOBLE-METAL SWITCHING RELAYS FOR DIAL OFFICES. H.Vogel.

Siemens - Z., Vol. 34, No. 4, 174-5 (April, 1960). In German.

A short review of the trend of development in the telephone switching art is followed by a description of the special features of the high-speed noble-metal switching relay that is designed for Siemens dial systems.

- 621.318.5  
BIBLIOGRAPHY OF RELAY LITERATURE 1957-1958.  
5539 Trans Amer. Inst. Elect. Engrs III, Vol. 79, 39-42  
(1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

- 621.318.53  
AN ELECTRO-IONIC STATIC CONTROL DEVICE.  
5540 S.R.Ovshinsky.  
Direct Curr., Vol. 4, No. 8, 242-5 (March, 1960).  
For abstract, see Abstr. 7187 of 1959.

- 621.318.56  
SPECIAL QUALITY MINIATURE RELAYS.  
5541 N.E.Hyde.  
Brit. Commun. and Electronics, Vol. 7, No. 5, 338-45 (May, 1960).  
Gives a conventional analysis of relay operation, discusses contact contamination and describes a sealed relay with permanent-magnet restraining armature to open position, a sealed relay of similar operational characteristics and compares these with semiconductor type relays in very general terms. R.W.J.Cockram

- 621.318.56.056.6  
THE "HERKON" HERMETICALLY SEALED CONTACT.  
5542 H.Rensch.  
Elektrotech. Z. (E.T.Z.) B, Vol. 12, No. 12, 295-7 (June 13, 1960).  
In German.

These relays have two spring reeds which carry contacts at their ends placed in a sealed glass tube filled with a shielding gas. The contacts are operated by a magnet coil wound round the outside of the tube. In this manner the contacts are protected from attack by the ambient atmosphere, and from dust deposits and moisture. It is also impossible later to alter the setting of the relay unintentionally. The requisite operating power is very small. The contacts withstand a very high number of operations running into hundreds of millions.

## ELECTROSTATICS . CAPACITORS

- 621.319.33 : 621.317.333.8  
CALCULATION OF THE CURRENT IN NON-LINEAR SURGE-CURRENT-GENERATOR CIRCUITS.  
5543 T.F.Monahan.  
Proc. Instn Elect. Engrs, Monogr. 376S, publ. April, 1960 (Vol. 107C, 288-91, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 2863 of 1960.

- 621.319.4  
SOME MECHANISMS OF FAILURE OF CAPACITORS WITH MICA DIELECTRICS. A.A.New.  
5544 Proc. Instn Elect. Engrs, Paper 3261 M, publ. July, 1960 (Vol. 107 B, 357-64).

During investigations of mica capacitor failures of various equipments during the last ten years and studies to improve their reliability, many mechanisms of failure have been examined. The principal features of the mechanisms are described and illustrated, and are summarized in tabular form for quick reference. Some methods of examination and dissection of these capacitors with the minimum loss of evidence are given in detail. This work does not imply that the proportion of mica capacitors which fail in service is excessive. Some of the causes of failure would occur in other types of capacitor, perhaps to a similar extent.

- 621.319.4  
STUDY OF THE LIFE EXPECTATION OF PAPER CAPACITORS. J.P.Mayeur.  
5545 Schweiz. tech.Z. (S.T.Z.), Vol. 57, No. 20, 419-23 (May, 1960).  
In French.

To find the statistical life of a capacitor type, lots of ten are taken and the time of individual failure plotted. Accelerated life testing was carried out by running experiments at 60°, 70°, and 80°C, and, as failure is normally due to physical or chemical deterioration of the dielectric, it may be assumed that Arrhenius' law applies, and hence the accelerated figures can be converted to normal life figures with not more than a 2 : 1 error. The effects of higher voltages are not so easily allowed for, and capacitors are tested at three different voltages, a simple graphical extrapolation enabling the life expectation to be calculated for any other voltage. W.D.Gilmour

- 621.319.5 : 621.359.4  
ELECTROSTATIC PRECIPITATORS.  
5546 H.J.White and W.A.Baxter, Jr.  
Mech. Engng, Vol. 82, No. 5, 54-6 (May, 1960).

A brief description of an investigation to assess the factors governing the performance of collecting plates. Solid surfaces were found to have better electrical characteristics than either expanded or perforated sheets. Wind-tunnel tests showed that better dust collection was achieved with triangular baffles than with flat projections. Tests were then carried out on prototype solid plates with triangular baffles to compare their performance with existing expanded metal-plate designs. The former were superior as regards dust collection, mechanical strength and rappability. Test results are available on 13 out of 50 installations now using this new design of plate and all have exceeded the guarantee efficiency. A.E.Kay

- 621.319.5 : 621.311.2  
AN ELECTROSTATIC DUST MONITOR.  
5547 D.H.Grindell.  
Proc. Instn Elect. Engrs, Paper 3184 S, publ. Jan., 1960 (Vol. 107A, 353-62; 362-5, Aug., 1960).  
Republication, with discussion, of the paper already abstracted as Abstr. 769 of 1960.

- 621.319.5 : 621.359.4  
THE ELECTRICAL CLEANING OF GASES. A FUNDAMENTAL PROBLEM IN THE OPERATION OF ELECTROFILTERS: COUNTER-EMISSION. M.Pauthenier.  
5548 Rev. gen. Elect., Vol. 69, No. 3, 175-84 (March, 1960). In French.  
The basic ideas and equations governing electrical precipitation in a cylindrical electrode system are summarized. The origin and behaviour of counter-emission is then discussed in some detail and equations are derived for the simple case of a uniform deposit of dust on the collecting electrode. Consideration is then given to the effect of counter-emission on the performance of electrical precipitators. A.E.Kay

- 621.319.523 : 537.54  
IMPROVED VERSIONS OF THE CASCADE GENERATOR.  
5549 G.Reinhold, J.Seitz and R.Minkner.  
Z. Instrumkde, Vol. 67, No. 10, 258-65 (Oct., 1959). In German.  
An analysis of the conventional Cockroft-Walton cascade generator leads to the conclusion that ripple and losses limit the maximum output to approximately 2 MeV. It is shown that a modified, symmetrical version can reach very much higher voltages. Some details of a 4 MeV machine constructed by the authors are given. E.A.Ash

## LAMPS . ILLUMINATION

- 621.32  
THERMAL PROBLEMS IN FLUORESCENT LAMP FITTINGS. S.Andersson.  
5550 Elektrotekniker, Vol. 56, No. 10, 216-21 (May 23, 1960). In Danish.  
The object of the investigation was to determine the most suitable design of fittings for various fluorescent lamp sizes and outputs and to determine correction curves for use when changing over from one lamp size to another. The relative luminous flux is shown as a function of temperature for a 4 × 80 W lamp fitting without ventilation and a 2 × 40 W fitting with ventilation, these being extreme cases. The large flux variations obtained are due to changes in the Hg-vapour pressure with temperature. The lamp light output as a function of temperature was measured by determining the impedance of the lamp, this being a function of Hg pressure. Curves are plotted showing luminous flux as a function of current at 220 V. A set of 13 curves is shown for various fitting designs showing light output as a function of air temperature. Measurements indicate the importance of slots in the fittings for ventilation purposes. G.N.J.Beck

- 621.326  
AN IODINE INCANDESCENT LAMP WITH VIRTUALLY 100 PER CENT LUMEN MAINTENANCE.  
5551 E.G.Zubler and F.A.Mosby.  
Illum. Engng, Vol. 54, No. 12, 734-40 (Dec., 1959).  
The cyclic reaction between tungsten and iodine is described



and the filament and bulb-wall temperatures at which the tungsten is removed from the wall and deposited on the filament are discussed. Suitable bulb materials are quartz, Pyrex and Vycor. Limitation of the rate of the reaction is achieved by filling the lamp with argon. The use of a cylindrical bulb eliminates convection heat losses. Filament supports and pinch seals are discussed. Difficulties with thermal diffusion separation of iodine, interference due to impurities and impossibility of gettering are mentioned. The new lamps have considerable advantages in respect of size, lumen maintenance, life and efficiency, a range of performance data being given.

C.E. Williams

621.326.7

## APPLICATIONS OF THE QUARTZ LIGHTING LAMP.

5552 C.J. Allen and R.L. Paugh.

Illum. Engng, Vol. 54, No. 12, 741-8 (Dec., 1959).

After an account of the principal characteristics of the lamp with a tungsten filament in iodine vapour, enclosed in a quartz tube, a number of applications are described. The form of the source, a line filament, makes it easy to obtain a beam which is very narrow ( $6^\circ$ ) in the plane perpendicular to the lamp axis. It is therefore very suitable for airport runway lighting. Its small bulk makes it useful for photosynthesis in naval and space travel. It can also be used with advantage in a number of more ordinary lighting fields.

J.W.T. Walsh

621.326.7

## INCANDESCENT LAMP DESIGN LIFE FOR RESIDENTIAL LIGHTING. W.M. Potter and K.M. Reid.

5553 Illum. Engng, Vol. 54, No. 12, 751-7 (Dec., 1959).

A re-examination of the problem of finding the most economical life for filament lamps. It is concluded that for domestic use present design life is much longer than can be justified on purely economic grounds, but a need for more frequent replacement would probably be unpopular.

J.W.T. Walsh

621.327.42

## STRAY CAPACITANCES IN NEON INSTALLATIONS.

5554 J.J. Wilting.

Philips tech. Rev., Vol. 21, No. 7, 207-17 (1959-60).

621.327.534 : 621.316.728

## A CONSTANT-VOLTAGE BALLAST FOR TWO OR MORE MERCURY LAMPS. V.W. Olson.

5555 Illum. Engng, Vol. 55, No. 2, 79-86 (Feb., 1960).

The ballast comprises a mains-connected leakage-reactance transformer with parallel-connected load circuits each consisting of a high-pressure mercury lamp in series with a capacitor. The voltage regulation under conditions of varying supply voltage is discussed and compared favourably with conventional ballasts. Tests on running conditions and hot or cold starting in the event of failure of one or more of the lamps are described. The simultaneous operation from the same ballast of two or more lamps of different rating is described. Some practical advantages of multiple-lamp ballast are mentioned and ten-lamp ballasts are visualized.

C.E. Williams

621.327.534 : 621.316.721

## IMPROVED MERCURY LAMP TRANSFORMER FOR MAXIMUM REGULATOR LOADING ON SERIES

5556 CIRCUITS. M.E. Robertson.

Illum. Engng, Vol. 55, No. 2, 87-98 (Feb., 1960).

The loading limitations of the moving-coil constant-current regulator supplying a series circuit of high-pressure mercury lamps are discussed. Attention is given to the allowance to be made for the failure of a proportion of the lamps. Arguments in favour of the use of an isolating transformer per lamp are given. It is shown that the modification of the turns ratio and primary inductance in such transformers leads to better exploitation of regulator characteristics and allows more lamps to be operated per circuit than has hitherto been advisable.

C.E. Williams

621.327.534

## NEW DESIGNS FOR MERCURY LAMPS INCREASE THEIR USEFULNESS. W.S. Till and M.C. Unglert.

5557 Illum. Engng, Vol. 55, No. 5, 269-81 (May, 1960).

Short notes on a number of constructional improvements for quartz lamps are given. (i) Double-coil oxide electrode for improved starting characteristics, life and maintenance. (ii) New technique of sealing direct into quartz tube. (iii) Better arc tube support structure. (iv) Reduction of size of starting resistor. (v) Quartz

collar to eliminate mercury bridging electrodes. (vi) Trend towards hard glass outer envelopes. (vii) Date coded bases for installation records. Economic implications of life and lumen maintenance gains are studied. The reaction of starting characteristic improvement on ballast design is discussed. Lamp nomenclature is described and the availability of different ratings is indicated.

C.E. Williams

621.327.534 : 621.387

## MICROWAVE NOISE IN GLOW DISCHARGES.

See Abstr. 5112

621.327.534.15

## SLOW DECAY RATES OF PHOSPHORS IN FLUORESCENT LAMPS. C.W. Jerome.

5558 Illum. Engng, Vol. 55, No. 12, 769-73 (Dec., 1959).

Oscillograms of the light output of fluorescent lamps run on d.c. or a.c. were used to show the presence of a very fast decay process in all the phosphors tested. Those with manganese activator had a much slower exponential process in addition. The exponential constants are given, and percentage flicker is calculated from the proportions of fast and slow decay.

S.T. Henderson

621.327.534.15

## SIGNIFICANT ADVANCES IN THE DESIGN OF NON-CIRCULAR CROSS-SECTION FLUORESCENT LAMPS.

J.O. Aicher and E. Lemmers.

5559 Illum. Engng, Vol. 55, No. 1, 39-44 (Jan., 1960).

A description of improvements over earlier types of power groove lamps which have been obtained by placing depressions on alternate sides of the lamp and increasing their number thus effectively increasing arc length, modifying the cross-section and providing specially designed cold spots. Special techniques for precision measurements of characteristics are required owing to mercury stabilization effects. Data are given for three ratings of lamp.

C.E. Williams

621.327.534.15

## EVALUATION OF METHODS FOR LOCALIZED COOLING OF FLUORESCENT LAMPS IN OUTDOOR LUMINAIRES.

M.E. Keck.

5560 Illum. Engng, Vol. 55, No. 2, 102-8 (Feb., 1960).

Depression of lamp performance due to elevated temperatures within fittings is described. Cooling of the lamps by localized or distributed forced draughts, thermoelectric devices or thermally conducting members is discussed, relative advantages of the different methods being enumerated. Operating characteristics of fittings incorporating such arrangements are given. Substantial luminous gains are claimed.

C.E. Williams

621.327.534.15

## NEW PARAMETERS FOR HIGH FREQUENCY LIGHTING SYSTEMS. J.H. Campbell.

5561 Illum. Engng, Vol. 55, No. 5, 247-56 (May, 1960).

Efficiency data for fluorescent lamps at constant wattage with various inert gas fillings, pressures, bulb diameters and power loadings are given for a frequency range from 60 c/s to 20 kc/s. Electrical characteristics are given for selected lamp types and an explanation of their variation in terms of electrode losses and positive column properties is offered. Generation and distribution of power at these frequencies is discussed. Choice of optimum frequency and possibilities of standardization are considered. Reference to some practical installations is made.

C.E. Williams

628.92

## SIMPLIFIED SKY COMPONENT EQUATIONS FOR

5562 A C.I.E. STANDARD OVERCAST SKY. T.N. Seshadri.

Curr. Sci., Vol. 29, No. 5, 174-5 (May, 1960).

Formulae are given for the sky component of daylight factor (direct skylight) from a narrow window when the sky luminance is: (a) uniform; (b) that adopted internationally for average overcast conditions. It is shown that the errors introduced by the use of these formulae with windows of normal width are not large.

J.W.T. Walsh

628.971

## USE OF THE CONCEPT "STREET SURFACE BRIGHTNESS" IN PUBLIC LIGHTING PRACTICE. J.B. de Boer.

5563 Bull. Assoc. Suisse Elect., Vol. 51, No. 12, 585-95 (June 18, 1960). In German.

A principal factor in achieving visibility in a street at night is

the surface brightness of the carriageway, but this quantity is difficult to measure because at the very low angle of view of a driver, about 1°, the vertical angle subtended by a limited length of road surface is very small. A photoelectric telephotometer designed for making such measurements is described. By using a multiplier photocell and transistors, the necessary accuracy can be obtained with a portable instrument of moderate bulk and weight.

J.W.T. Walsh

# RELATIVE VISUAL COMFORT EVALUATIONS OF

5564 ROADWAY LIGHTING. C.H. Rex and J.S. Franklin.

Illum. Engng, Vol. 55, No. 3, 161-74 (March, 1960).

The Guth "discomfort glare evaluator" (see Abstr. 224 of 1960) was applied to the study of comfort conditions in street lighting. The work was carried out in a full-scale experimental street by 52 observers, using three luminance levels, viz. 0.1, 1 and 10 ft-L. The results obtained were found to confirm the conclusions of previous workers. It is shown that the use of the evaluator can give guidance in the design of street lighting installations.

J.W.T. Walsh

# BRIDGE LIGHTING ON SHIPBOARD AS INFLUENCED BY RECENT PHYSIOLOGICAL RESEARCH. W. Adrian.

Lichttechnik, Vol. 12, No. 6, 351-4 (June, 1960). In German.

In modern ships the lighting of the numerous instrument dials is liable to cause the navigator considerable glare, especially on dark nights. An experimental investigation of this effect is described and the advantages of using red light are given. For equal illumination the reduction of visual sensitivity was found to be one-tenth of that experienced with white light. Equal legibility of dial markings could be obtained with less than one-third of the illumination if red light was used. The effect of the general level of luminance was also investigated.

J.W.T. Walsh

# COMPARISON OF VISIBILITY MEASUREMENT SYSTEMS. A.A. Eastman and S.K. Guth.

Illum. Engng, Vol. 55, No. 3, 176-84 (March, 1960).

The Luckiesh-Moss "visibility meter" depends on reducing both the luminance and the contrast of the task to threshold. In the Blackwell "visual task evaluator" only contrast is reduced. Results given by the two instruments in finding the illumination required to give equal visibility for a number of visual tasks are compared. Satisfactory agreement is found in a number of cases; discrepancies are explained.

J.W.T. Walsh

# SIMPLE AND RAPID DETERMINATION OF WINDOW DIMENSIONS NEEDED FOR LIGHTING. E. Hochstätt.

Lichttechnik, Vol. 12, No. 5, 297-9 (May, 1960). In German.

The window dimensions necessary to give a specified daylight factor can be found by using two graphs. The first gives the ratio of the window area to the floor area of the room, in terms of the angle of elevation of external obstructions seen through the window; the second gives the height of the window head for different values of this angle and of the depth of the room.

J.W.T. Walsh

# THE APPLICATION OF TRANSISTOR UNITS TO LIGHTING IN VEHICLES. A. Rister.

Siemens-Z., Vol. 34, No. 4, 271-2 (April, 1960). In German.

With the aid of transistors, inverter units have been developed for the operation of fluorescent lighting from vehicle batteries. This obviates the need for motor-generator sets. In order to keep the temperature rise within the permissible limits, the transistorized inverters are designed in two halves which are arranged at either end of the lighting fitting. A description is given of its practical application for the interior lighting of a bus.

628.972

# ELECTROLUMINESCENT SOURCES IN AUTOMOTIVE INSTRUMENT LIGHTING. J.M. Harris and P.J. Blinkilde.

Illum. Engng, Vol. 55, No. 1, 32-7 (Jan., 1960).

A description of the construction and characteristics of the ceramic-on-metal light source, its operation from a battery driven transistor oscillator and its use for the illumination of typical automobile instruments. The performance of this type of lighting is assessed in relation to other techniques.

C.E. Williams

## ELECTROCHEMISTRY

621.352.6

### FUEL CELLS.

5570 A.M. Moos.

Industr. engng Chem., Vol. 52, No. 4, 291-2 (April, 1960).

This is the introductory paper of a group presented at a Symposium on fuel cells of the Division of Gas and Fuel Chemistry One-Hundred and Thirty Sixth Meeting, 13th-18th September, 1959, Atlantic City, N.J. It outlines the principles of fuel cells, how they can be classified, and military and commercial uses to which they might be applied. Abstracts of the other papers are given below and complete versions of those papers are to be published in book form by the Reinhold Publishing Co., in the summer of 1960.

A.P. Paton

### FUEL CELLS AS ELECTROCHEMICAL DEVICES.

5571 H.A. Liebhafsky and D.L. Douglas.

Industr. engng Chem., Vol. 52, No. 4, 293-4 (April, 1960).

Briefly defines the term fuel cell which is a source of i.v. d.c. produced by direct action of air or oxygen in converting a conventional fuel into electrical energy without the disadvantage of the Carnot cycle. Desirable features and operational characteristics required are discussed with some notes on the chemistry involved.

A.P. Paton

### CARBONACEOUS FUEL CELLS.

5572 H.H. Chambers and A.D.S. Tantram.

Industr. engng Chem., Vol. 52, No. 4, 295-6 (April, 1960).

Describes research by the Soudes Place Research Institute, Dorking, England, to develop the Davtyan "solid" electrolyte high-temperature cell and discusses suitability of various fuels, electrolytes, and development of two types of cell. One is a porous diaphragm cell with an electrolyte of sodium and lithium carbonates held in a porous sintered magnesia disk with identical electrodes consisting of porous layer silverized zinc oxide. The other employs free molten electrolyte with 2-layer electrodes of the Bacon Cell type (Brit. Pat. 667298). Some performance data are given.

A.P. Paton

### HYDROGEN-OXYGEN FUEL CELLS WITH CARBON ELECTRODES. K. Kordes.

5573 K. Kordes.

Industr. engng Chem., Vol. 52, No. 4, 296-8 (April, 1960).

Deals with cells developed in the Union Carbide Consumer Products Co., laboratories consisting of an outer porous carbon tube exposed to air, a 30% potassium hydroxide electrolyte, and a porous inner tube into which hydrogen is fed. The theory of the action is discussed and results for a number of electrode arrangements are given with some performance figures.

A.P. Paton

### CATALYSIS OF FUEL CELL ELECTRODE REACTIONS. G.J. Young and R.B. Roselle.

5574 G.J. Young and R.B. Roselle.

Industr. engng Chem., Vol. 52, No. 4, 298-300 (April, 1960).

Examines the role played by a catalyst surface on electrodes of fuel gas cells in relation to hydrogen, acetylene, ethylene and carbon monoxide with various groups of metals involved. Catalytic action at the oxygen electrode is also discussed.

621.352.6

### ELECTRODE KINETICS.

5575 L.G. Austin.

Industr. engng Chem., Vol. 52, No. 4, 300-1 (April, 1960).

Analyses the three main factors causing voltage loss within a fuel cell—activation polarization, mass transport polarization, and ohmic resistance—with appropriate formulae for the reactions occurring.

A.P. Paton

### THE HIGH PRESSURE HYDROGEN-OXYGEN FUEL CELL. F.T. Bacon.

5576 F.T. Bacon.

Industr. engng Chem., Vol. 52, No. 4, 301-3 (April, 1960).

Describes the construction and performance of the Bacon cell which operates at 200°C and 300-600 lb/in.<sup>2</sup>. A 5 to 10 kW cell complete with automatic controls has been constructed and 40 of

them have operated in series without special difficulties being encountered. Questions of control of gas admission and removing water formed as a waste product are still under consideration.

A.P.Paton

621.352.6

## 5577 HIGH TEMPERATURE FUEL CELLS.

G.H.J. Broers and J.A.A. Ketelaar.

Industr. engng Chem., Vol. 52, No. 4, 303-6 (April, 1960).

Describes experimental work on a modified form of the Davtayan cell with particulars of the construction and curves showing performance attained. The cells operate between 550 and 700°C on town's gas, hydrogen, carbon monoxide, or natural gas, and the chemical reactions involved are discussed.

A.P.Paton

621.352.6

## 5578 NATURE OF THE ELECTRODE PROCESS.

E. Gorin and H.L. Recht.

Industr. engng Chem., Vol. 52, No. 4, 308-9 (April, 1960).

A study of the reaction mechanism of the electrodes derived from data obtained in the range of 700-800°C using hydrogen-steam mixtures and carbon monoxide-dioxide mixtures at the anode and air at the cathode. Voltage-current characteristics were analysed statistically and specific internal resistances were measured and calculated, various equations being given for actual contact area, rate of gas permeation, and polarization.

621.352.6

## 5579 MOLTEN CARBONATE CELLS WITH GAS-DIFFUSION ELECTRODES.

D.L. Douglas.

Industr. engng Chem., Vol. 52, No. 4, 308-9 (April, 1960).

An investigation of the behaviour of electrodes in a mixture of lithium, sodium and potassium carbonates which melts at about 400°C and is thermally stable to above 800°C. Particulars are given of the various electrodes used and of means for estimating internal resistance, with curves showing polarization figures for silver and for nickel anodes, with equations for some of the reactions involved.

A.P. Pat

621.352.6

## 5580 FUEL CELL PANEL DISCUSSION.

G.J. Young.

Industr. engng Chem., Vol. 52, No. 4, 310 (April, 1960).

This briefly summarizes points discussed following presentation of the papers at the Symposium. They included suggestions as to the best way to furnish the fuel required, questions of fuel storage, difficulties in cell construction and operation, and future prospects, which are fairly good if sufficient investment is made to develop them.

A.P. Paton

621.357 : 621.314.63

## 5581 APPLICATIONS OF SEMICONDUCTOR RECTIFIERS IN LARGE AND MEDIUM POWER ELECTROCHEMICAL INSTALLATIONS.

R. Perrett.

Bull. Sci. Assoc. Ingen. Montefiore (A.I.M.), Vol. 73, No. 1, 5-66 (Jan., 1960). In French.

Reviews the electrical requirements of the electrochemical industry, how they have been met in the past, and the present use of germanium and silicon converters. The construction and characteristics of semiconductor converters are described, with examples of their arrangement in electrochemical installations giving outputs of up to 100 000 A 600 V. Protection and regulation are considered, and typical values given for the various losses, and for the power factor and cost. Many recent installations in France are described with illustrations and diagrams.

E.F. Hansford

621.357.7 : 621.372.8

## 5582 ELECTRO-PLATING ON SILVERED PLEXIGLAS.

ITS APPLICATION TO MANY HIGH FREQUENCY

PROBLEMS. G. Raoult and R. Fanguin.

J. Phys. Radium, Vol. 20, Suppl. No. 4, 29 A-31 A (April, 1959). In French.

Describes the method of vacuum silvering of Plexiglas formers followed by copper-electroplating to produce highly polished silver-plated cavities on waveguides for high frequency transmission.

W.A. Walker

## ELECTRIC HEATING

621.36 : 621.577

5583 HEAT PUMP PROGRESS IN GREAT BRITAIN (WITH SPECIAL REFERENCE TO D.C. OPERATED THERMO-ELECTRIC HEAT PUMP DESIGNS). M.V. Griffith.

Direct. Curr., Vol. 4, No. 8, 238-42 (March, 1960).

621.362 : 621.382

## RECENT PROGRESS IN THERMOELECTRICITY.

S.J. Angello.

Elect. Engng, Vol. 79, No. 5, 353-7 (May, 1960).

See also the four following abstracts.

621.362 : 621.382

5585 MEASUREMENT OF THE PARAMETERS IN THE THERMOELECTRIC FIGURE OF MERIT. E.H. Lougher.

Elect. Engng, Vol. 79, No. 5, 358-64 (May, 1960).

Some of the more effective methods for measuring such important parameters of thermoelectric materials as Seebeck coefficient, thermal conductivity, and electrical resistivity are described.

621.362

5586 A THERMOELECTRIC REFRIGERATING SYSTEM FOR SUBMARINES. R.G. Sickert.

Elect. Engng, Vol. 79, No. 5, 364-71 (May, 1960).

An investigation for determining the feasibility of this system is divided into three phases: (1) general investigation of cooling capacity and performance of thermoelectric couples; (2) design of a refrigerating system for a large frozen stores room and a smaller chilled stores room; and (3) determination of the performance and operation of the entire system.

621.362

5587 MEASUREMENT OF MATERIALS FOR THERMO-ELECTRIC GENERATORS. C.S. Duncan and G.W. Wilson.

Elect. Engng, Vol. 79, No. 5, 372-8 (May, 1960).

Presents various aspects of thermoelectric generator material measurement. Characteristics which the various measurements can reveal, and those which are needed for a specific purpose are discussed.

621.362

5588 THERMOELECTRIC REFRIGERATION.

W.L. Wright.

Elect. Engng, Vol. 79, No. 5, 380-4 (May, 1960).

Several devices which represent applications in the electronics industry and medicine are described.

621.362 : 637.533

5589 CONTRIBUTION OF ANODE EMISSION TO SPACE CHARGE IN THERMIONIC POWER CONVERTERS.

A.F. Dungan.

J. appl. Phys., Vol. 31, No. 8, 1397-1400 (Aug., 1960).

The space charge theory of Langmuir has been extended to include the effects of anode emission on the performance of a vacuum thermionic power converter. The basic equation is similar to Langmuir's  $\xi-\eta$  equation, but it involves two additional parameters which depend on the temperatures and thermionic properties of the electrodes. An iterative technique is described for obtaining solutions in specific cases, and some sample calculations based on hypothetical diodes are presented. The calculations indicate that the effect of the anode temperature is considerably more pronounced if the cathode-anode work function difference is large.

621.365.22

5590 THE ELECTRICAL CIRCUIT OF A 3-PHASE SHUNTED ARC[FURNACE]. I.T. Zherdev.

Elektrichestvo, 1960, No. 2, 46-52 (Feb.). In Russian.

In an electric arc furnace there are multiple current paths from the electrodes via the layers of material to be smelted and via the conducting lining. These can be represented by equivalent circuits shunting the arc. The resultant equivalent circuit is analysed in considerable detail and enables the instantaneous values of voltage and current to be determined. The calculated waveform is shown to approximate very closely to that obtained in practice.

J.S. Wilson



- 621.365.3  
**5591 STEAM PRODUCTION WITH ELECTRODE BOILERS.**  
 O.R.Blomberg.  
 Tekn. Ukeblad, Vol. 107, No. 20, 421-7 (May 19); No. 21, 451-4 (May 26, 1960). In Norwegian.  
 Formulae are derived for the design of electrodes giving the current per cm<sup>2</sup> of electrode surface flowing into the water and the contact resistance. It is shown that the electrode system should be

designed to minimize the effect on the current of the steam formed and to enable steam bubbles to be conducted rapidly away. The electrode system of the Penzold boiler is described in more detail. Surface arcing at high voltages has to be prevented and a.c. electrolysis is avoided by using cast-iron electrodes. H.V. boilers are regulated by raising or lowering the water level. Boilers may be designed with insulated neutral to avoid possible danger from earth currents. The economics of electrode boiler application is also discussed.  
 G.N.J.Beck

## ELECTRIC WAVES AND OSCILLATIONS

- 621.371  
**5592 ON THE ELECTRO-MAGNETIC RADIATION FROM A VERTICAL DIPOLE OVER THE SURFACE OF ARBITRARY SURFACE IMPEDANCE.** K.Furutsu.  
 J. Radio Res. Lab. (Tokyo), Vol. 6, 269-91 (April, 1959).  
 A rigorous and explicit solution is obtained for the problem of the electromagnetic radiation from a vertical dipole located over a flat surface of arbitrary surface impedance  $Z$ . The solution is valid throughout the whole range of frequency and space. Though there are four asymptotic expansions, the expansion by Hadamard's method seems to have the most explicit physical meaning. According to this expansion, only the ordinary surface wave can be present explicitly on the condition of  $\arg \sqrt{1 - Z^2} > \pi/4$ . On the other hand, variation of the field over a spherical surface due to the change of surface impedance is investigated by the use of the ordinary Van der Pol and Bremmer formula with slight modification. In this case, when  $\arg(Z) > \pi/3$  and  $Z$  is large than some definite value  $Z_0$ , one of the terms of the formula is found to have the asymptotic form similar to the surface-wave term in the flat surface case and, when the surface is highly inductive, it becomes the leading term at a large distance from the dipole. The height-gain factor of this term first decreases rapidly with height up to some point and then gradually increases. On the other hand, when  $Z \ll Z_0$ , the leading term can scarcely have the correspondence with that in flat surface case. Finally, the propagation of surface wave over spherical surface across several boundaries of discontinuity of the surface impedance is considered. The leading term is found to take the simple form as in the ordinary transmission line. The results in the case of a flat plane are derived from these results as asymptotic forms in the limit of infinite radius of curvature of spherical surface.

along a line can be calculated from its terminating impedance. These are applicable to lines having any continuous distribution of local characteristic impedance ( $Z$ ) along their length. The first method is to use the Runge-Kutta method of solving the differential equation for  $Z$  starting at the load end. The second is to consider the line as a series of uniform lines of equal length each having a value of  $Z$  equal to the average value over the corresponding part of the original line. The transformation through the equivalent line is carried out step by step. For the case of an exponential line, values of impedance were calculated by both methods and compared with those determined from the exact equations. Good approximations can be obtained by these methods if an electronic computer is available.  
 W.T.Blackband

- 621.372.4  
**5595 ON SOME THEOREMS CONCERNING PASSIVE LINEAR NETWORKS.** F.Gasparini.  
 Alta Frequenza, Vol. 29, No. 1, 90-5 (Feb., 1960). In Italian.  
 A simple demonstration of Cohn's theorem for passive linear dipoles is reported. An extension of this theorem is then presented by which it is possible to obtain some of the power properties of such dipoles.

- 621.372.412  
**5596 A NEW TYPE OF PIEZO-ELECTRIC FLEXURAL VIBRATOR IN THE FORM OF BALANCED CANTILEVERS.** S.Ayers.  
 Proc. Instn Elect. Engrs, Monograph 391 E, July, 1960, 15 pp.  
 [To be republished in Part C].

The flexural vibrator, designed to vibrate about 1 kc/s, basically consists of identical cantilever arms extending from a common area to form a symmetrical element. Two distinct shapes have been considered - the H and the "zigzag". Some of the H elements have uniform cross-section while others are arranged to have most of their mass at the free ends in order to reduce the frequency for a specimen of given length. The "zigzags" have folded arms of any number of sections (increasing the number of sections reduces the frequency). The theory of the various forms and their frequency equations are derived. Conditions for perfect balance of the reactions at the supports are discussed. Measurements have been made on H and "zigzag" forms made from quartz slices  $ZYb\phi(\phi = 0 - 10^\circ)$  and on "zigzag" form from EDTXY(tl  $\phi$ ,  $90^\circ$ ,  $90^\circ$  Frequency, temperature behaviour, Q-factor and displacement patterns of the elements are compared with theory. Since some of the conventional driving methods proved unsatisfactory a short section is included on circuits.

## LINES . NETWORKS . FILTERS

- 621.372  
**5593 THE GENERALIZED MATRIX THEORY OF NON-HOMOGENEOUS LINES.** A.L.Fel'dshtein.  
 Radiotekhnika, Vol. 15, No. 6, 10-17 (June, 1960). In Russian.  
 Applies the normalized transmission wave matrix  $[T]$  to considering a cascade connection of arbitrary passive quadripoles. The summator equations of the network are obtained by ordinary matrix algebra. These equations connect the  $[T]$  of the chain as a whole with the transmission matrices of the individual quadripoles. The particular case of a smoothly non-homogeneous v.h.f. line is represented by a passage to the limit, which leads to integral equations for the elements of the  $[T]$  in question. These last equations are solved by successive approximations. Differentiation of the integral equations with respect to the upper limit yields the corresponding differential equations for the elements of  $[T]$ . The functions obtained for the elements of  $[T]$  are components of the solution of the Riccati equation for the non-homogeneous line. Only the main outlines of the working are given, with suitable references to the literature.  
 D.E.Brown
- 621.372.2  
**5594 THE CALCULATION OF [TRANSMISSION] LINES HAVING IMPEDANCE VARYING IN A CONTINUOUS MANNER.**  
 A.V.J.Martin and F.J.Young.  
 J. Phys. Radium, Vol. 19, Suppl. No. 7, 65A-70A (July, 1958). In French.  
 Two methods are described by which the variation of impedance

- 621.372.413 : 621.317.41  
**5597 PERTURBATION THEORY OF RESONANT CAVITIES.**  
 R.A.Waldron.  
 Proc. Instn Elect. Engrs, Monogr. 373E, publ. April, 1960 (Vol. 107C, 272-4, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 2887 of 1960.

- 621.372.413  
**5598 TUNING A CROSS-SHAPED CAVITY RESONATOR BY MEANS OF A FERRITE.**  
 A.I.Tereshchenko, N.M.Kovtun and S.D.Dmitriev.  
 Zh. tekhn. Fiz., Vol. 29, No. 11, 1418-19 (Nov., 1959). In Russian.  
 English translation in: Soviet Physics-Technical Physics (New York), Vol. 4, No. 11, 1307-8 (May, 1960).  
 A slab of ferrite replaces one metal surface of a waveguide, whose cross-section is shaped as a cross. A much wider tuning range can be obtained than in a rectangular waveguide using the same ferrite slab.  
 A.H.W.Beck

- 621.372.5 : 621.317.332.1  
**5599 THE DETERMINATION OF THE HYPERFREQUENCY CHARACTERISTIC IMPEDANCE OF A GIVEN QUADRIPOLE.** S.Lefevre.  
 C.R.Acad. Sci. (Paris), Vol. 250, No. 20, 3288-9 (May 16, 1960). In French.  
 Describes a graphical method of obtaining the characteristic impedance from the results of measurements of input impedance made with a specified termination. V.G.Weisby  
 621.372.5
- 5600 ANALYSIS OF ALL-PASS NETWORKS.** G.Wunsch.  
 Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 169-76 (Jan., 1960). In German.  
 It is shown that a transfer function  $A(p)$  is an all-pass transfer function when and only when  $A(p) = k(-p)/l(p)$ ,  $k$  being a finite, real constant. All-pass networks are then classified in four main groups, according to the characteristics of their input and characteristic impedances, and some realizable equivalents to the basic elements of lattice networks are given. It is also shown that every all-pass network which, with equal terminations, has a driving point transfer function = 1, can be derived from two basic elements. W.G.Stripp  
 621.372.5
- 5601 A WAVE-PARAMETER THEORY FOR MECHANICAL QUADRIPOLES IN COMPRESSIONAL OR TORSIONAL OSCILLATION.** C.Kurth.  
 Nachrichtentechnik, Vol. 9, No. 11, 490-502 (Nov., 1959). In German.  
 The formal analogy between a mechanical oscillator and its electrical counterpart is exploited and extended to include distributed circuits. The more interesting properties of critical lengths of mechanical transmission line are described and tabulated. S.C.Dunn  
 621.372.512.26
- 5602 TRANSFORMATION OF UNBALANCED AUDIO-FREQUENCY SIGNALS INTO BALANCED SIGNALS WITHOUT PHASE ERRORS.** K.Homilius.  
 Elektronik, Vol. 9, No. 3, 83-6 (March, 1960). In German.  
 In a theoretical introduction the most important requirements for obtaining transformation without phase error are explained. It appears that the loss resistance of the transformer as well as the internal resistance of the generator voltage applied to the primary windings should be as small as possible. The mutual inductance of the transformer which should be as high as possible can be obtained by using core material with a high permeability. To obtain an input voltage with low internal resistance an emitter amplifier with impedance transformation is used. Expressions are given for calculating this resistance and a numerical example is worked out. E.Maanders  
 621.372.54
- 5603 ANALYSIS OF MULTI-LAYER TRANSMISSION LINE FILTERS.** K.Takiyama.  
 Doshisha engng Rev., Vol. 10, No. 1, 1-28 (June, 1959).  
 The analysis follows conventional network theory and the various matrices and image parameters of a filter section are calculated. The conditions under which infinite insertion loss is realized are discussed in detail and an explanation of its physical meaning is offered. When many-filter sections are connected in cascade, the image parameters are most useful for determining the characteristics of a complete filter, and the results of the discussion concerning the characteristics of the image parameters are tabulated.  
 621.372.54
- 5604 APPROXIMATION THEORY FOR FILTER NETWORKS.** H. Watanabe.  
 J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 271-80 (March, 1960). In Japanese.  
 A comprehensive design theory for filter networks, based on the theory of the Abelian integral, is described. An ideal transmission function can be defined as an Abelian integral  $\omega(\lambda)$  with certain stated properties. The application of appropriate analytic transformation techniques to  $\omega(\lambda)$  leads to a generalized characteristic function  $\phi(\lambda)$ , and all kinds of realizable transfer functions can be derived by the use of linear transformations of  $\{\phi(\lambda)\}^2$  with regard to  $\lambda^2$ . Design methods are given for filter networks having either a single pass band or two pass bands which have Chebyshev characteristics. These methods are applied to the practical design of (1) a band-pass filter containing 6 coils, whose transfer function  $N$  is of order 13; (2) a band-pass filter using 4 coils, with  $N = 10$ ; (3) a double-pass-band filter with  $N = 8$  and using 4 coils. All three have Chebyshev performance in their pass bands. A.Wilkinson  
 621.372.54 : 537.3
- 5605 LOW FREQUENCY WAVE FILTERS EMPLOYING THERMISTORS.** R.A.Rasmussen.  
 Rev. sci. Instrum., Vol. 31, No. 7, 747-51 (July, 1960).  
 A review of the general properties of thermistors and analyses of their small signal characteristics are presented. Measurements of their a.c. properties and response curves obtained for the simplest filter circuit configurations are then described and the results analysed.  
 621.372.6
- 5606 AUDIO ISOLATION NETWORKS.** H.Korkes.  
 J. Audio Engng Soc., Vol. 8, No. 2, 132-4 (April, 1960).  
 Describes passive networks designed to transmit signals between certain terminal pairs but not between others, the desired isolation being obtained by providing multiple transmission paths so that signals following an undesired path cancel out. Simple examples are the Wheatstone bridge and the hybrid coil. More complicated examples include: (1) a stereo matricing network where the sum and difference output signals are derived from the right-hand and left-hand input channels; and (2) conference networks whereby each of a small group of speakers can hear all the others but not himself. H.G.M.Spratt  
 621.372.3
- 5607 VOLTAGE AND CURRENT TRANSFORMATION MATRICES.** I.Cederbaum.  
 Proc. Instn Elect. Engrs. Monogr. 355, publ. Feb., 1960 (Vol. 107C, 145-9, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 791 of 1960.  
 621.372.6 : 621.317.76
- 5608 A THEORY OF STEADY FORCES IN VARIABLE-PARAMETER NETWORKS.** W.E.Smith.  
 Proc. Instn Elect. Engrs. Monogr. 366 M, publ. Feb., 1960 (Vol. 107C, 228-33, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 2901 of 1960.  
 621.372.6 : 517.524
- 5609 FURTHER THEORY OF A CERTAIN CONTINUED FRACTION.** O.P.D.Cutteridge.  
 Proc. Instn Elect. Engrs. Monogr. 367 M, publ. Feb., 1960 (Vol. 107C, 234-7, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 2251 of 1960.  
 621.372.6
- 5610 A REVIEW OF THE PROBLEMS, METHODS AND RESULTS OF THE THEORY OF LINEAR NETWORKS.** G.Wunsch.  
 Wiss. Z. Tech. Hochsch. Dresden, Vol. 8, No. 4, 843-57 (1958-9). In German.  
 A three-part article, this first part dealing with the historical development of both analysis and synthesis and discusses the classification of network systems. The more important theorems are stated and a distinction drawn between the various specific methods developed for synthesis. There are 81 references. S.C.Dunn  
 621.372.6 : 621.357.7
- PRODUCTION OF SILVER-PLATED PLEXIGLAS WAVEGUIDES.** See Abstr.5582  
 621.372.621
- 5611 RADIATION FROM DISCONTINUITIES IN STRIP-LINE.** L.Lewin.  
 Proc. Instn Elect. Engrs. Monogr. 358 E, publ. Feb., 1960 (Vol. 107C, 163-70, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 1502 of 1960.

- 621.372.826  
5612 POWER FLOW AND NEGATIVE WAVE IMPEDANCE IN THE DIELECTRIC-ROD WAVEGUIDE. E.F.F. Gillespie. Proc. Instn. Elect. Engrs, Monogr. 362 E, publ. Feb., 1960 (Vol. 107C, 198-201, Sept., 1959).

Republication of the Monograph already abstracted as Abstr. 604 of 1960.

- 621.372.829 : 538.56  
5613 ELECTROMAGNETIC WAVES IN A SPIRAL GUIDE FILLED WITH AN ANISOTROPIC DIELECTRIC.

V.P. Shestopalov, V.A. Silyusarskii, S.D. Andrenko and E.I. Chernyakov. Zh. tekh. Fiz., Vol. 30, No. 6, 644-52 (June, 1960). In Russian.

Gives a derivation and discussion of the dispersion equation and the distribution of power flow in a spiral guide filled with an anisotropic dielectric. Two cases are considered: (1) the spiral is wound on a cylindrical anisotropic dielectric and placed in a tube made of an isotropic dielectric; (2) the cylindrical anisotropic dielectric is placed in a tube made of an isotropic dielectric on which the spiral is wound. The experimental results quoted confirm the theoretical conclusions. J.K. Skwirzynski

- 621.372.83  
5614 SOME OBSERVATIONS OF WAVEGUIDE COUPLING THROUGH MEDIUM-SIZED SLOTS. L. Lewin.

Proc. Instn. Elect. Engrs, Monogr. 359 E, publ. Feb., 1960 (Vol. 107C, 171-8, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 1506 of 1960.

- 621.372.831  
5615 A METHOD FOR THE EVALUATION OF EQUIVALENT CIRCUIT PARAMETERS OF AN ASYMMETRIC WAVEGUIDE JUNCTION. J.K. Sinha.

Proc. Instn. Elect. Engrs Monogr. 381 publ. May, 1960 (Vol. 107C, 324-9, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3528 of 1960.

- 621.372.833  
5616 GENERALIZED THEORY OF COUPLED LOCAL NORMAL MODES IN MULTI-WAVE GUIDES.

Huang Hung-chia.

Scientia Sinica, Vol. 9, No. 1, 142-54 (Jan., 1960).

A generalized theory of coupled local normal modes is developed, and a systematic mathematical method is introduced to solve problems of multi-coupled modes in waveguides with slowly varying parameters, which involve systems of linear differential equations with slowly varying coefficients. To illustrate the applicabilities of the method, the problem of a bend with slowly varying curvature is solved by considering two and three coupled modes successively. For the two coupled modes case, the results agree with those of Louisell (Abstr. 5227 of 1955) and Unger (Abstr. 282 and 5399 of 1958). Solution for the three coupled-modes problem has not appeared in the literature heretofore. Further applications are discussed.

- 621.372.837.2 : 621.387  
THE USE OF A HOT-CATHODE GAS-FILLED DIODE FOR THE RAPID AND BRIEF INTERRUPTION OF VERY-HIGH-FREQUENCY RADIOWAVES. See Abstr. 5106

- 621.372.85 : 538.56  
5617 THEORETICAL AND EXPERIMENTAL RESULTS CONCERNING LOADED WAVEGUIDES AND PARTIALLY COAXIAL CAVITIES. R. Combe and M. Feix.

Nuovo Cimento, Vol. 15, No. 5, 760-73 (March 1, 1960). In French.

Gives a method of resolving systems of equations governing the problem of the dispersion relation in a disk-loaded circular waveguide and the problem of the eigenvalue frequency in hybrid cavities used as klystron resonators and wavemeters. By Fourier analysis of the field components up to the sixth order, good agreement between theoretical and experimental results is obtained.

- 621.372.851.2 : 538.56  
5618 HALF-ROUND INDUCTIVE OBSTACLES IN RECTANGULAR WAVEGUIDE. D.M. Kerns.

J. Res. Nat. Bur. Stand., Vol. 64B, No. 2, 113-30 (April-June, 1960).

Formulae are derived for the accurate calculation of the lowest-mode, lumped-element representation of perfectly conducting half-round inductive obstacles in rectangular waveguide. These obstacles consist of either one or two opposed semicircular cylindrical indentations extending across the narrow sides of the waveguide.

They seem especially suitable for use as precise calculable standards of reflection or impedance in waveguide. Schwinger's integral equation approach is used to obtain stationary expressions for the desired parameters as functionals of the surface currents on the obstacles. Upper bounds are obtained for one of the two parameters. Explicit formulae are derived for the values of the parameters under the assumption of  $n$ -term Fourier sine-series expansions for the obstacle currents. Rapid convergence is indicated by numerical evaluations for  $n = 1, 2$ , and  $3$ . In the process of obtaining expressions suitable for numerical calculation, an expansion (believed to be new) of the Green's function of the problem is obtained and the sums of certain infinite series of Bessel's functions occurring in this expansion are expressed in terms of definite integrals. A brief numerical table of these sums, sufficient for the evaluation of the  $n = 1$  approximation, is included.

- 621.372.852.2  
5619 ELECTRONICALLY-VARIABLE PHASE SHIFTERS UTILIZING VARIABLE CAPACITANCE DIODES.

R.H. Hardin, E.J. Downey and J. Munushian.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 944-5 (May, 1960).

Phase shifters operating in the v.h.f. and microwave region utilizing two type-HPA.2800 diodes are described. The diodes are so arranged in two arms of a hybrid junction or circulator so that the other two arms, used as input and output, are isolated from each other. The phase of the output can then be controlled by varying the voltage on the diodes. Using mainly stripline techniques phase-shifters have been constructed at 0.5, 1.0, 6.0, 9.0. kMc/s, with phase shifts of  $180^\circ$  at 1.0 kMc/s and  $41^\circ$  at 9.0 kMc/s, the insertion loss varied from 1.2dB at 1 kMc/s to 3.9dB at 9kMc/s but varied with the magnitude of the phase shift. A.P.C. Thiele

- 621.372.852.2  
5620 REFLECTION OF LONGITUDINALLY POLARIZED WAVES FROM A RECTANGULAR RIDGED STRUCTURE.

L.N. Deryugin.

Radiotekhnika, Vol. 15, No. 5, 9-16 (May, 1960). In Russian.

Discusses diffraction of plane electromagnetic waves on a rectangular ridged structure (a "comb") and deduces equations for the reflection coefficient of waves polarized along and at right angles to the ridges. A. Tybulewicz

- 621.372.852.4  
5621 GENERATING A ROTATING POLARIZATION.

P.J. Allen.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 941 (May, 1960).

The combination of two oppositely sensed circularly polarized waves of the same frequency results in a linearly polarized wave, the plane of which depends on the relative phases of the component waves. If the frequencies of the circularly polarized waves are different there will be a constant rate of change of relative phase between them and the resulting linearly polarized wave will rotate at a constant rate. Such a wave may be generated by a two-port circularly polarized aerial consisting of a circular-waveguide dual-mode transducer incorporating a quarter-wave plate.

H.L. Natrass

## OSCILLATORS . PULSE GENERATORS

- 621.373.4  
5622 LOW-FREQUENCY NOISE GENERATOR.

D.A. Bell and A.M. Rosie.

Electronic Technol., Vol. 37, No. 6, 241-5 (June, 1960).

A low-frequency noise generator covering the range 0-50 c/s and flat to within 1 dB over this range was made by mixing the noise from a 2D21 thyratron, amplified in a 2 kc/s amplifier with a  $\pm 75$  c/s bandwidth, with a 2 kc/s Wien bridge thermistor-stabilized local oscillator, in a silicon junction diode ring modulator. The output from the modulator was passed through a low-pass filter and a d.c. amplifier. This circuit avoids the troubles from mains hum and flicker noise that would be present if direct noise generation were used. The amplitude distribution of the generator output was measured by applying the output to a c.r.t. equipped with a slit, and viewing the trace with a photomultiplier, whose output was proportional to the fraction of the time spent by the spot of light in the slit. Appendices on the analysis of the spectrum of clipped narrow-band noise and the amplitude distribution of a sinusoidal time function are included. W.D. Gilmour



The deviation curves for two short flights in unpressurized DC-3 aircraft are given. In the longer flight the maximum time uncertainty was 150 nanosec.

A.H.W.Beck

621.373.4 : 529

# 5623 PRELIMINARY FLIGHT TESTS OF AN ATOMIC CLOCK IN PREPARATION OF LONG-RANGE CLOCK

SYNCHRONIZATION EXPERIMENTS. F.H.Reder and G.M.R.Winkler. Nature (London), Vol. 186, 592-3 (May 21, 1960).

621.373.4

# 5624 IMPULSE-GOVERNED OSCILLATOR TECHNIQUES. I. C.J.de Lussanet de la Sablonière.

Philips telecomm. Rev., Vol. 21, No. 2, 78-90 (Oct., 1959).

The i.g.o. is a special type of integrating loop control system, using a master oscillator working directly on the final frequency, or a submultiple of it. The oscillator frequency is synchronized with a harmonic of a crystal oscillator, or with a mixing product of two stable oscillators. General outlines and practical aspects of i.g.o. techniques are described. Possible circuit diagrams, applying the principles described, are given, and the differences from other solutions are explained. Further special circuits and theoretical data will be given in subsequent articles.

621.373.4

# 5625 IMPULSE-GOVERNED OSCILLATOR TECHNIQUES. II. C.J.de Lussanet de la Sablonière.

Philips telecomm. Rev., Vol. 21, No. 4, 155-65 (April, 1960).

The survey of basic i.g.o. properties is continued by a discussion of modulation and keying techniques. A number of examples of elementary circuits are then given, such as the i.g.o. with phase feedback, the i.g.o. with combined frequency and phase discriminator (of which the Image Selective Circuit forms a special version) and the i.g.o. with double pulse mixing. Auxiliaries such as the hunting circuit are examined and, finally, some attention is paid to the requirements an i.g.o. exciter has to meet.

621.373.422 : 538.56

# 5626 MILLIMETRE WAVES FROM MERCURY ARC HARMONIC GENERATOR. K.D.Froome.

Nature (London), Vol. 186, 959 (June 18, 1960).

Harmonic generation from a small high-pressure mercury arc has been extended to using a 1 W 8 mm waveband klystron as the fundamental. The sixth harmonic (1.43 mm wavelength) was detected with a Golay cell, giving a power of about  $10^{-6}$  W. The fourth harmonic, was 15 dB stronger. Improvements of about 100 times should be possible if a more efficient matching arrangement can be devised.

D.Walsh

621.373.43

# 5627 GENERATION OF PULSE OSCILLATIONS OF STABLE FREQUENCY. V.A.II'in.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 323-5 (May 11, 1960). In Russian.

Frequency-stable oscillators can be obtained by using a bridge which includes in its diagonal arm a diode whose forward and reverse resistances are of a similar order of magnitude; then  $df/f$  ( $f$  = frequency of a pulse oscillator) is less than 1% for 100% change in supply voltage. The arrangement can also be used as a blocking oscillator.

J.K.Skwirzynski

621.373.444

# 5628 A SURVEY OF SWEEP GENERATORS. R.Brown.

Brit. Commun. and Electronics, Vol. 7, No. 4, 270-7 (April, 1960).

The basic principles, facilities available and method of use for both general and special-purpose instruments are presented. Three tables are given referring to British instruments only, they include details of manufacturer, frequency range, output, sweep width, time base, distortion and amplitude variation during sweep, frequency calibration, measurement accuracy, special facilities available and price.

A.P.C.Thiele

621.373.5 : 621.397.611

# TV-WAVEFORM GENERATION. See Abstr. 5254

621.373.52

# 5629 A HIGH FIELD EFFECT TWO-TERMINAL OSCILLATOR. R.W.Lade and T.R.Schlax.

Proc. Inst. Radio Engrs., Vol. 48, No. 5, 940-1 (May, 1960).

The negative resistance region of the inverse-voltage charac-

teristic of a readily available semiconductor device is used to produce an oscillator of good sinusoidal output. A plea for lower breakdown voltage devices is made.

A.Szwiecki

621.373.531.4

# 5630 A TRANSISTOR RELAXATION OSCILLATOR AND ITS APPLICATION. E.Büchle.

Elektronik, Vol. 9, No. 3, 68-72 (March, 1960). In German.

The transistorized Schmitt trigger circuit is described in detail, characterized by a part common-emitter load and a d.c. coupling from first collector to second base. The concise calculation of the threshold operation in terms of supply voltages,  $I_{cb}$ ,  $I_{eb}$ ,  $\alpha$  and  $f_{\alpha}$  values is given. Thermal stabilization and upper frequency limits are discussed; measurements and calculation show reasonable agreement and some typical applications are enumerated and illustrated by non-dimensioned circuit diagrams.

A.Landman

## PULSE CIRCUITS . DIGITAL CIRCUITS SWITCHING CIRCUITS

621.374.3

### DESIGNING INPUT TRIGGER CIRCUITS.

R.Kimes.

Electronic Industr., Vol. 19, No. 2, 101-5 (Feb., 1960).

Describes a thermionic Schmitt trigger with variable trigger-voltage level designed to produce an output pulse virtually independent of input rise-time and to reject noise.

D.J.Truslove

### 5632 A TIME-AMPLITUDE CONVERTOR WITH A RESOLUTION TIME OF $10^{-10}$ SECOND.

J.Samuels and A.Sarazin.

J. Phys. Radium, Vol. 19, Suppl. No. 7, 109A-110A (July, 1958). In French.

Conversion of very short time intervals to pulse amplitudes enables standard pulse height analysers to be used. In the circuit given, pulses from two channels are shaped to a constant amplitude and duration  $A$ , and are then applied to  $g_1$  and  $g_2$  of a 6BE7 valve. These grids are cross-connected to those of a second 6BE7, to obtain symmetrical control. The output pulse, of duration  $A - t$ , is integrated to give a pulse of amplitude proportional to  $A - t$  where  $t$  is the separation.

W.G.Stripp

621.374.3 : 529

### 5633 TIME ANALYSER USING A CRYSTAL-CONTROLLED TROCHOTRON TUBE. T.Dobrowolski and J.Walker.

J. sci. Instrum., Vol. 37, No. 6, 289-91 (Aug., 1960).

A nine-channel timing system is described in which a crystal oscillator has its output switched by a starting signal and is then used to drive a beam-switching tube (Burroughs, type MO-10R). An accurate sequence of voltage impulses is thus produced and these operate conventional circuits which gate the signals to be timed. The accuracy of the system is discussed briefly.

621.374.32

### 5634 A UNIVERSAL TEN-CHANNEL TIME ANALYZER. G.Ivanyi and F.Szlávik.

Exper. Tech. der Phys., Vol. 8, No. 1, 25-34 (1960). In German.

An apparatus for measuring the time distribution of electrical impulses, whether random or of a set pattern. The incoming pulses are routed, in discrete or overlapping time intervals, to counters or printers by means of selector, timing and gating circuits. Block schematic diagrams and circuit details of some of the circuits are given.

H.G.M.Spratt

621.374.32

### 5635 THE USE OF DECADE COUNTER TUBES IN NON-DECIMAL COUNTING SYSTEMS. K.Apel.

Elektron. Rdsch., Vol. 14, No. 3, 95-7 (March, 1960). In German.

The principles of operation of a cold-cathode decade-counting tube are explained. The tube employs only one guide cathode between each pair of main cathodes and transfer of the glow is effected by a single negative pulse applied to all guide cathodes. (The direction of transfer is apparently predetermined by the physical arrangement of the electrodes). An arrangement of two tubes is then described in

which a common anode-load resistor is used and a discharge can exist in one tube only, being transferred from one tube to another by a negative pulse applied to one cathode of the extinguished tube. A detailed circuit is given, suitable for operation in this manner, of the particular tubes described.

G.H.Stearman

621.374.32

5636 RING COUNTER FOR FORWARD AND REVERSE COUNTING USING TRANSISTORS. K.Wagner.

Elektron. Rdach., Vol. 14, No. 4, 121-5 (April, 1960). In German.

Two ring counters for forward and reverse counting are described, composed of bistable multivibrator stages using low frequency OC71 transistors. Low impedance, common collector, driver stages are used which permit a maximum of eleven "and"-gates to be connected. Performance specifications and minimum resolution times for the two types considered are also given.

M.Goldberg

621.374.32

5637 FAST RING COUNTER.

V.E.Bandura and N.I.Borodin.

Priborostroenie, 1959, No. 8. In Russian. English translation in: Instrum. Constr., 1959, No. 8, 12-15 (Aug.).

Development of expressions for the design of stable, reliable ring counters comprising chains of bistable valve circuits arranged so that one only of the interstage couplings is conductive at any time to successful triggering from a common input line. Valve characteristic and component tolerances are taken into account and a sample design is given. A practical ten-stage counter operated successfully at 500 kc/s.

G.H.Stearman

621.374.32

5638 THE DESIGN AND USE OF INSTRUMENTS FOR COUNTING LOCAL LIGHTNING FLASHES. F.Horner.

Proc. Inst. Elect. Engrs, Paper 3238 E, publ. July, 1960 (Vol. 107B, 321-30).

Instruments for counting local lightning flashes are reviewed and reasons are given for selecting one particular design for extensive tests. The importance of the aerial configuration is stressed. A 7 m vertical aerial has been adopted as a standard and the instruments have normally been adjusted to trigger on a 3 V signal from a built-in calibrator, corresponding to a field change of about 3 volts/m. With this arrangement, on a day on which thunder is heard, there is usually a maximum hourly count exceeding 30 and a total daily count exceeding 100. The effective range of a counter is defined in statistical terms and techniques for its measurement are discussed. Preliminary estimates of the effective range are derived from observations on a few local storms in England; with the standard instrument it is about 30 km. More observations are required to confirm the results, particularly in countries with frequent thunderstorms. Equipment should be standardized so far as possible.

621.374.32 : 539.1.07

5639 ANTI-COINCIDENCE CIRCUIT FOR USE IN THE MILLI-MICROSECOND REGION. R.Madey and D.A.Barge.

Rev. sci. Instrum., Vol. 31, No. 6, 664-5 (June, 1960).

A simple crystal diode anti-coincidence circuit that can be activated by 4 msec pulses is described. At 10 msec about the coincident time the response is reduced by 200 times.

D.Walsh

621.374.32 : 539.1.07

5640 HIGH SPEED SCALERS USING TUNNEL DIODES. P.Spiegel.

Rev. sci. Instrum., Vol. 31, No. 7, 754-5 (July, 1960).

A solid-state scaler circuit has been developed with a double pulse resolution of less than 50 nsec. It utilizes the characteristic of series-connected tunnel diodes wherein voltage is a multi-valued function of current. The decade scaler described requires very little power, may be microminaturized, and is potentially more economical and easier to fabricate than contemporary scalars.

621.374.32

5641 THE PASSAGE OF R.F. PULSES THROUGH LINEAR SYSTEMS WITH DELAYED FEED-BACK. A.N.Nedeshev.

Radiotekhnika, Vol. 15, No. 5, 26-8 (May, 1960). In Russian.

Considers the variation in the r.f. content  $f$  of a square pulse applied to the input of a linear amplifier tuned to  $f_p$  ( $f \neq f_p$ ) with feed-back via a delay line, the degree of feed-back being much greater than the pulse length. The output voltage after  $n$  circulations is obtained by the operational method; transformation and differentiation of this expression gives the required law of variation of  $f$ .

D.E.Brown

5642 CONTACTLESS RELAY WITH TRANSISTORS. F.L.Varpakhovskii and R.A.Lipman.

Avtomat. i Telemekh., Vol. 19, No. 11, 1028-35 (1958). In Russian.

Two basic circuits are considered; a two-stage relay (d.c. coupled switch), with common-emitter stage and a three-stage relay, the second transistor sharing a common collector load with the third, of which the emitter load is again shared with the first stage. Criteria for switch action in terms of  $I_b$ ,  $\beta$  and load values are derived, illustrated by voltage and current characteristics. A full analysis of switch action follows, based on threshold values of positive feedback. Typical values of input voltage for "on" and "off" conditions versus various circuit parameters are calculated and plotted, showing good agreement with measured values. Practical relays, using P3, P4 and P6 transistors, are then described, achieving output powers of 100-200 W with a gain of  $10^3$  to  $10^5$ . [English summary: PB 141096T-12, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.].

A.Landman

621.374.32 : 621.318.57

5643 THE DESIGN OF A SEMICONDUCTOR RELAY. S.V.Kulikov.

Radiotekhnika, Vol. 15, No. 4, 73-80 (April, 1960). In Russian.

A relay with 2 complementary pairs of transistors, 2 diodes and 4 thermistors is described. Using a "conditionally autonomous tripole concept", a method of calculating the temperature stabilization and performance characteristics of the relay is developed. A more elaborate circuit, with 2 additional transistors, which has certain advantages including simple adaptation to pulse-duration modulation, is briefly described. Results of experiments with a relay of the simpler type are given.

F.Quelon

621.374.32

5644 TRANSISTOR SWITCHES AND STATIC SWITCHING CIRCUITS. M.J.Bouscasse.

Bull. Soc. Franc. Elect., Vol. 1, 227-39 (April, 1960). In French.

An elementary non-mathematical introduction to transistor logical circuits covering gates, counters, binary elements, shift registers, etc. and their application to industrial processes.

W.D.Gilmour

621.374.32

5645 SYNTHESIS OF THE SEQUENTIAL CIRCUIT BY BOOLEAN MATRICES. K.Kinoshita and H.Ozaki.

J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 265-71 (March, 1960). In Japanese.

Describes a method of synthesis by means of the Boolean matrices defined by Campeau (see Abstr. 4225 of 1958). The matrices are obtained as the coefficients of Boolean functions, expressed in the standard sum form. Synchronous sequential circuits consisting of combinational circuits with delay elements are first considered and the identity matrix, showing all possible combinations of inputs and present states, is derived. This enables a sequential circuit to be synthesized when a state diagram is given. The case in which the delay element is replaced by a flip-flop circuit is also treated. Examples of the synthesis of both types of circuit are shown.

A.Wilkinson

621.374.32

5646 SWITCHING CIRCUITS DESIGN WITH THE AID OF DEVELOPED METHODS OF LOGICAL SYNTHESIS.

A.W.Rauch.

Ingeniøren C, Vol. 4, No. 1, 2-21 (March, 1960).

A resumé of basic principles in switching algebra leads to the development of a formal method of synthesizing circuits in which the output state of a network is included as one of the controlling variables determining that state. These are sequential and locking circuits, examples of both being discussed. Standard simplification methods are assumed, but further simplification is shown to be possible in some cases by the introduction of semiconductor diodes into the networks. The principles established are applied in detail to the design of a relay control circuit and sequence memory for a transfer machine, which may be called upon to operate in a total of 4328 different manners. Finally the design of cyclic to pure code converters is discussed.

G.H.Stearman

621.374.32

5647 MICROMINIATURIZING A SPACE VEHICLE COMPUTER. E.Keonjian.

Electronics, Vol. 33, No. 18, 95-8 (April 29, 1960).

Describes approaches to decreasing the size of digital computers

comprising tens of thousands of components. The basic sub-assembly is a 0.5 by 0.5 by 0.03 inch wafer upon which resistors and capacitors are deposited and unencapsulated silicon transistors and diodes are soldered to form an entire functional circuit. Methods of interconnection and packaging are described which give a density  $\sim 6 \times 10^5$  parts/ft<sup>2</sup>.

D.J.Truslove

#### 621.374.42 5648 STUDY OF THE PHASE STABILITY OF A FREQUENCY MULTIPLIER CHAIN. M.Olivier.

Ann. Franc. Chronom., Vol. 14, No. 1, 15-32 (1960). In French.

The phase stability of a conventional frequency multiplier used for comparing the frequency of a standard quartz frequency generator with maser-type oscillators is examined. It is found that operating temperature has the greatest effect on stability. Such a multiplier converting from 100 kc/s to 5 Mc/s is shown to have a phase stability corresponding to a frequency stability of less than  $2 \times 10^{-11}$  over a period of 10 sec. The method of phase measurement is discussed in detail.

A.P.C.Thiele

## AMPLIFIERS

(Abstracts on magnetic amplifiers appear also under Inductors, Reactors)

#### 621.375.1 5649 NOVEL APPROACH TO PULSE AMPLIFIER DESIGN. J.F.Golding.

Electronics, Vol. 33, No. 19, 64-6 (May 6, 1960).

In any pulse amplifier the steepness of the output-pulse edges is limited by the current available for charging the output shunt capacitance. A circuit using an auxiliary amplifier to provide the short-duration charging current drawn by the shunt capacitance during the transient parts of the pulse is described. The required amplifier standing current is thereby reduced and gain improved. Formulae are given for calculating the peak charging current required and fastest rise-time obtainable without instability. The design of an experimental amplifier, giving a 50 V output pulse with rise time of 0.1  $\mu$ s across a capacitive load of 100 pF and using two auxiliary amplifiers for positive and negative inputs, is also included. See also Abstr. 7336 of 1959.

M.Goldberg

#### 621.375.2 5650 EQUALIZED STEREO PREAMPLIFIER FOR PROFESSIONAL USE. E.P.Skov.

J. Audio Engng Soc., Vol. 8, No. 2, 120-5 (April, 1960).

The amplifier is intended for use with both stereo and monophonic disks, employing a stereo pick-up cartridge for both types. To accommodate different types of cartridge, two alternative input circuits are provided, a direct high-impedance valve input and a step-up transformer with 600, 150 and 37.5 ohm taps. The output stage is a feedback pair with transformer output. Details of equalization and distortion figures are given.

H.G.M.Spratt

#### 621.375.221.1 5651 STAGGER-TUNED AMPLIFIERS WITH MAXIMUM LINEARITY OF PHASE AND AMPLITUDE CHARACTERISTICS. G.Cartianu.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 3, 75-86 (Sept., 1959). In German.

Using the expression for the transfer function defined by poles and zeros, the phase and amplitude characteristics of several multi-stage amplifiers are calculated and tabulated. The distortion for a frequency-modulated input is also calculated and is shown to be substantially less than when synchronous tuning is employed.

W.G.Stripp

#### 621.375.3 : 621.316.718 5652 THE APPLICATION OF MAGNETIC AMPLIFIERS TO DECK AUXILIARIES. H.Augustin.

A.E.G.Mitt., Vol.49, No. 10-11, 598-605 (Oct.-Nov., 1959). In German. The preferred arrangement is a transducer-controlled Ward Leonard system. Various performance curves are shown for deck winches, anchor motors and follow-up rudder control systems. Extensive use is made of encapsulated transducers and rectifier stacks.

S.C.Dunn

621.375.3

#### 5653 GRAPHICAL CIRCUIT ANALYSIS OF THE FULL-WAVE MAGNETIC AMPLIFIER WITH SQUARE-LOOP CORE MATERIALS. K.Murakami and T.Kikuchi.

E.T.J. Japan, Vol. 5, No. 2, 61-3 (1959).

621.375.3

#### 5654 ELIMINATION OF COUPLING PROBLEMS IN MULTI-STAGE MAGNETIC AMPLIFIERS. W.McMurray.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 858-63 (1960) = Commun. and Electronics, No. 46 (Jan., 1960).

Describes the basic circuit, a 2-stage half-wave magnetic amplifier, where a rectifier-type synchronous switch effectively couples the stages during the gating half cycle of stage 1 and decouples the stages during the resetting half cycle of stage 1. Applies this circuit to full-wave amplifiers and analyses a two stage full-wave amplifier when stage 2 is a centre-tap circuit. Lists the advantages and disadvantages of the method.

D.J.Truslove

621.375.4

#### 5655 ON THE BEHAVIOUR OF A NON-LINEAR TRANSISTOR AMPLIFIER NEAR ITS LIMIT OF STABILITY.

L.Gumowski.

C.R.Acad. Sci. (Paris), Vol. 250, No. 19, 3142-4 (May 9, 1960). In French.

The carrier transit time of transistor amplifiers may depend on the signal level; thus, when large feedback ratios are employed, a non-linear effect becomes apparent at frequencies approaching the  $\beta$  cut-off frequency. It is shown that, by considering higher order equations, a good approximation to the stability limits of such an amplifier can be obtained by a homogeneous differential operational equation of the first order.

W.D.Gilmour

621.375.9

#### 5656 RECENT ADVANCES IN LOW-NOISE U.H.F. AND MICROWAVE AMPLIFIERS. G.O.Chalk.

Brit. Commun. and Electronics, Vol. 7, No. 4, 258-65 (April, 1960).

Describes the principles of operation of the reactance amplifier and the various types of electron-beam parametric amplifiers. The noise properties and problems of application of the devices are discussed.

R.C.Glass

621.375.9

#### 5657 ANALYSIS OF FOCUSER FOR MASER OSCILLATORS. M.Hirono.

J. Radio Res. Lab. (Tokyo), Vol. 6, 515-32 (July, 1959).

The characteristics of an eight-pole focuser for a maser oscillator are examined and compared with those of four-pole and square-well focusers, taking into consideration the Maxwellian velocity distribution of the molecular beam. It is shown that the 8-pole focuser is intermediate between the other two types for the same maximum inner electric field. The variation of focusing action with change of some other parameters is also demonstrated. The shift of the centre frequency of the ammonia 3,3 line with change of focuser voltage is briefly discussed.

621.375.9 : 538.56

#### 5658 AN INTRODUCTION TO THE THEORY OF SOLID-STATE MASERS. P.N.Butcher.

Proc. Instn Elect. Engrs, Paper 3220 E, publ. Feb., 1960. (Vol. 107B, 341-51, 352-3).

Republication, with discussion, of the paper already abstracted as Abstr. 2350 of 1960.

621.375.9

#### 5659 EXTENSION OF LONGITUDINAL-BEAM PARAMETRIC-AMPLIFIER THEORY. H.Sobol.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 792-3 (April, 1960).

Analysis, including numerical results, of a model which allows coupling between signal and first upper and lower sidebands around the fundamental of the pump frequency. Eight waves are propagated; the upper sideband is heavily excited. Results appear to agree better with experiment than those of Louisell and Quate's model (Abstr. 3107 of 1958).

B.Meltzer

621.375.9

#### 5660 BANDWIDTH OF LOWER SIDEBAND PARAMETRIC UP-CONVERTERS AND PARAMETRIC AMPLIFIERS. S.T.Fisher.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 946 (May, 1960).

In a paper by Rowe (Abstr. 3654 of 1958) an expression for



gain is derived in terms of stability factor and a frequency factor  $x$ . The expression did not however allow the bandwidth to be expressed in closed form. A simplified expression is derived for bandwidth and the  $(\text{gain})^{1/2}$ -bandwidth product allowing evaluation of any value of gain from zero to infinity. A.P.C.Thiele

621.375.9

5661 THE DIODE-LOADED HELIX AS A MICROWAVE AMPLIFIER. G.Conrad, K.K.N.Chang and R.Hughes. Proc. Inst. Radio Engrs, Vol. 48, No. 5, 939-40 (May, 1960).

Exploratory work with a helix loaded with p-n junction diodes in an attempt to develop a broadband and directional four terminal amplifier is described. The helix (made of silver-plated tungsten wire) is 6 in. long and has a mean diameter of 0.276 and 13 turns per in. the diodes are of germanium, alloy-diffused, mounted between the turns of the coil. The position of each diode, pump power and pump frequency were found critical. A typical amplifier utilizing two diodes was operated with signal frequency of 2800 Mc/s, pump frequency 3800 Mc/s and 60 mW pump power and had a gain of 26 dB with a voltage gain bandwidth of 30 Mc/s and a noise figure of 5-7 dB. Such structures can be tuned by varying the pump power and frequency. A.P.C.Thiele

621.375.9

5662 A FERROMAGNETIC AMPLIFIER USING LONGITUDINAL PUMPING. R.T.Denton. Proc. Inst. Radio Engrs, Vol. 48, No. 5, 937-8 (May, 1960).

Describes a ferromagnetic amplifier in which the r.f. magnetic field is parallel to the d.c. field. A c.w. gain of 25 dB at about 4000 Mc/s has been obtained for pump powers of less than 1 W. A.H.W.Beck

## MODULATION . DEMODULATION

621.376.2

5663 ON THE RECOVERY OF A BAND-LIMITED SIGNAL, AFTER INSTANTANEOUS COMPANDING AND SUBSEQUENT BAND LIMITING. H.J.Landau. Bell Syst. tech. J., Vol. 39, No. 2, 351-64 (March, 1960).

If  $f(t)$  is a band-limited function, with band limit  $-\Omega$  to  $\Omega$ , the result of instantaneously companding  $f(t)$  is in general no longer band-limited. Nevertheless, it has been proved that knowledge of merely those frequencies of the compander output which lie in the band from  $-\Omega$  to  $\Omega$  is sufficient to recover the original signal  $f(t)$ . An iteration formula has been proposed that, in theory, performs the desired recovery. Some of the practical questions raised by that formula are studied in detail. It is shown that the successive approximations converge to the solution  $f(t)$  at a geometric rate, uniformly for all  $t$ , and that the iteration procedure is stable. A method of performing

the recovery in real time is then described with a successful simulation of it on a general-purpose analogue computer. The circuit used in the simulation serves as a first approximation to a practical realization of the recovery scheme.

621.376.22

5664 TRANSISTOR MODULATORS FOR LOW-LEVEL DIRECT CURRENT SIGNALS. J.F.Evans. Nature (London), Vol. 186, 626-7 (May 21, 1960).

A symmetrical silicon transistor used with a symmetrical drive can give a drift rate of less than  $1.5 \mu\text{V}/^\circ\text{C}$  over a temperature range from  $-40^\circ$  to  $+100^\circ\text{C}$  without any adjustment or selection. C.Hilsum

621.376.3

5665 THE CALCULATION OF STEADY-STATE AND DYNAMIC AMPLITUDE AND FREQUENCY DISTORTION OF FREQUENCY-MODULATED WAVES, USING SERIES REPRESENTATION OF A GIVEN TRANSFER FUNCTION. E.G.Wochni. Hochfrequenztech. u. ElektAkust., Vol. 68, No. 3, 104-10 (Sept., 1959). In German.

Using approximate Taylor expansions of the transfer functions, distortion factors are obtained from the derivatives of the amplitude and phase characteristics. Separate expressions are obtained for frequency distortion in intermediate frequency filters, demodulator amplitude distortion, and distortion due to imperfect limiting. W.G.Stripp

621.376.3

5666 R.F.SPECTRA OF WAVES FREQUENCY MODULATED WITH WHITE NOISE. R.G.Medhurst. Proc. Inst. Elect. Engrs Monogr. 380, publ. May, 1960 (Vol. 107C, 314-23, Sept., 1960).

Republication of the Monograph abstracted as Abstr. 3635 of 1960.

621.376.332

5667 TRANSITION-RATE DISCRIMINATORS. J.D.Holland.

Elect. Commun., Vol. 35, No. 4, 261-5 (1959).

Telegraph signalling waveforms consist of a series of mark-space or space-mark transitions that represent points at which the rate of change of information is a maximum. This rate for an error-free message depends on the signalling speed and increases for perturbations due to noise. The differences in rates can be detected in a transition-rate discriminator and the information used to provide a utilization voltage. Such a discriminator for 50-baud operation is illustrated by a detailed circuit schematic and discussed in conjunction with typical graphs of results obtained. The application of the discriminator in dual-diversity radio receiving systems is particularly mentioned, and a block schematic for a dual-diversity switched aerial system shown. Reference is made to pending British Patent applications. W.J.Mitchell

## ELECTRONICS

### SEMICONDUCTOR MATERIALS AND DEVICES TRANSISTORS

621.382 : 539.2 : 537.311

5668 STUDY OF CHARGE CARRIERS IN SEMICONDUCTORS SUBJECTED TO AN INTENSE ELECTRIC FIELD. J.Bok. Ann. Radioelect., Vol. 15, 120-46 (April, 1960). In French.

Examines the behaviour of a semiconductor subjected to an intense electric field. A method of calculation is given, valid in the case of a large number of carriers, which makes it possible to calculate electron temperature and current as a function of applied electric field when the nature of the collisions of these electrons is known. This method is then applied to a number of cases and its validity is verified by experimental results. It is then shown how the electron temperature can have an influence on other secondary physical phenomena: generation of new carriers by shocks, thermoelectric effects due to hot electrons and emission of electrons out of the crystal.

621.382 : 539.2 : 537.3

5669 CONTACT ELECTRIFICATION OF SEMICONDUCTORS. W.R.Harper.

Brit. J. appl. Phys., Vol. 11, No. 8, 324-31 (Aug., 1960).

Recently published experimental findings on the electrification of rutile powder by sliding down a metal chute can be explained by an extension of the author's theory of the separation electrification of metals. The mechanism of the electrification of insulators must, in most cases, be quite different.

621.382.2 : 539.2 : 537.311

5670 ON THE THERMAL TURNOVER OF GERMANIUM RECTIFIERS. E.Nagy.

Acta phys. Hungar., Vol. 8, No. 1-2, 231-3 (1957).

It is shown that the dependence of turnover voltage on resistivity and mobility is the same as that deduced from the Zener breakdown mechanism.

621.382.2

5671 THERMAL CHARACTERISTICS OF SILICON DIODES. J.R.Madigan.

Electronic Industr., Vol. 18, No. 12, 80-8 (Dec., 1959).

Presents a qualitative discussion on the origin of temperature variations. The relationship between the rectifier barrier and Fermi levels accounts for most of the properties of the forward breakdown characteristic. A tentative explanation is given for the high rate of increase in reverse current with temperature. The Zener (negative temperature coefficient) and avalanche (positive temperature coefficient) breakdown mechanisms are reviewed. A relationship between the variation of reverse breakdown impedance with current and recombination radiation is suggested. 16 references.

P.Szekely

621.382.2 : 539.2 : 537.311

# 5672 DIODE CAPACITORS FOR PARAMETRIC AMPLIFICATION.

R.C.Knechtli and R.D.Weglein.  
J. appl. Phys., Vol. 31, No. 6, 1134-5 (June, 1960).  
Proposes a definition of the figure of merit of a diode capacitor which differs from that given previously by Mortenson (Abstr. 7399 of 1959). The new definition predicts an optimum doping level  $\sim 10^{17}$  donors/cm<sup>3</sup> for a Ge abrupt junction diode, which minimizes the noise temperature. It is claimed that this prediction is borne out in practise.

G.D.Sims

621.382.2 : 539.2 : 537.311

# 5673 COMMENTS ON "DIODE CAPACITORS FOR PARAMETRIC AMPLIFICATION" BY R.C.KNECHTLI AND R.D.WEGLEIN.

K.E.Mortenson.  
J. appl. Phys., Vol. 31, No. 6, 1135 (June, 1960).  
See preceding abstract. The author points out that his figure of merit differs from that proposed by Knechtli and Weglein only in the precise definition of the parameters used. A further improved definition (to be substantiated in a forthcoming paper) involving a Fourier capacitance coefficient of the pumped diode is given. The author defends his previous contention that the figure of merit of abrupt junction Ge diodes increases with decreasing doping.

G.D.Sims

621.382.2

# TUNNEL DIODE OPERATION AND APPLICATION.

I.A.Lesk and J.J.Suran.  
Elect. Engng., Vol. 79, No. 4, 270-7 (April, 1960).  
Outlines the mechanism of the tunnel ( $P_TN$ ) junction in producing a negative slope resistance, its application in a  $P_TNPN$  switch, its equivalent-circuit parameters, and some small-signal and switching-circuit applications. Disadvantages as well as advantages are noted.

F.F.Roberts

621.382.2

# NOISE FIGURE OF TUNNEL DIODE MIXER.

D.I.Breitner.  
Proc. Inst. Radio Engrs., Vol. 48, No. 5, 935-6 (May, 1960).  
The derivation of an expression for the noise figure is outlined, assuming that the only source of noise in the diode is the shot noise of the tunnel current. A typical value given by the expression is about 6 dB, compared with about 5 dB for the same diode as a negative resistance amplifier.

F.F.Roberts

621.382.22

# TUNNEL DIODES.

G.N.Roberts.  
Electronic Technol., Vol. 37, No. 6, 217-22 (June, 1960).  
Gives a clear description of the operation and characteristics, of the measurement of the latter and of the use of the device in oscillator and switching circuits.

F.F.Roberts

621.382.3

# NEGATIVE RESISTANCE IN TRANSISTORS BASED ON TRANSIT-TIME AND AVALANCHE EFFECTS.

H.N.Statz and R.A.Pucel.  
Proc. Inst. Radio Engrs., Vol. 48, No. 5, 948-9 (May, 1960).  
A device is proposed similar to the Read diode (Abstr. 4285 of 1956) which should exhibit negative resistance in the microwave region. A voltage of frequency far above  $\alpha$  cut-off is applied across the collector junction of a grounded-base transistor. Resulting oscillations of the collector space-charge region modulate the (d.c.) minority-carrier flow from the emitter which gives rise to a multiplied majority-carrier current at the collector junction, biased near avalanche breakdown. Whenever the frequency of this multiplied current is such that its phase changes by  $180^\circ$  across the collector space-charge region, a negative resistance is produced across the collector junction. The value of the negative resistance, and of a masking positive resistance, is deduced from the diffusion

equation. Typical calculation for a germanium structure predicts negative resistance at about 1 kMc/s. The avalanche mechanism restricts the linear voltage swing and introduces noise. The avalanche build-up time is assumed to be less than the period of oscillation for negative resistance.

C.Fromberg

621.382.3

# CHARGE ANALYSIS OF TRANSISTOR OPERATION.

A.N.Baker.  
Proc. Inst. Radio Engrs., Vol. 48, No. 5, 949-50 (May, 1960).  
An expression for the d.c. excess charge in the base region of a transistor is derived from the continuity equation, and from it is calculated the response of a grounded-emitter transistor to a step in base current. It is shown that reduction of emitter efficiency reduces the gain and improves the frequency response.

C.Fromberg

621.382.3

# THEORETICAL LIMITATIONS TO TRANSISTOR PERFORMANCE.

P.Aigrain and G.M.Philippe.  
Rev. E., Vol. 3, No. 2, 83-91 (1960). In French.  
Gives a detailed descriptive account of the limitations due to the approach to avalanche voltage breakdown, the fall of current gain at high current densities, and cut-off frequency due to base transit-time and its improvement in a graded base region.

F.F.Roberts

621.382.32

# OTHER SEMICONDUCTOR (DEVICE) STRUCTURES.

P.Aigrain and G.M.Philippe.  
Rev. E., Vol. 3, No. 2, 93-102 (1960). In French.  
Describes in detail the operation of the original unipolar transistor, of the technetron and of the alkatron, the latter having a central drain, an outer ring-form source and an intermediate ring-form gate, all on one face of a thin semiconductor wafer. Controlled rectifiers and parametric diodes are also outlined.

F.F.Roberts

621.382.323

# A NEW TYPE FIELD-EFFECT TRANSISTOR.

T.Hayashi.  
J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 298-305 (March, 1960). In Japanese.  
The transistor described consists of a grown p-n junction of Ge with source, drain and gate contacts. It is intended for use as a switching device. The highly doped n-type side forms the gate and a channel is cut on the p-type side by ultrasonic machining and etching. Design theories are derived for two cases: (a) when the mobility of carriers in the channel is constant; (b) when the mobility is proportional to  $E^{-1/2}$ , where E is the strength of the electric field. The static characteristics of several units are presented and analysed and found in good agreement with the above-mentioned theories. A typical transistor, of this type has a pinch-off voltage of 16 V when the value of the drain current is 1.5 mA. The frequency cut-off is  $\sim 20$  Mc/s.

A.Wilkinson

621.382.333

# APPLYING TRANSISTOR "Y" PARAMETERS.

V.G.K.Reddi.  
Electronic Industr., Vol. 19, No. 1, 79-82 (Jan., 1960).  
These are short-circuit admittances. They are measurable by simple bridge techniques. Their application in r.f. amplifier design is discussed and illustrated in an example of a neutralized single-stage amplifier (considering forward transfer admittance, potential stability and maximum neutralized power-gain).

A.Szaniecki

621.382.333

# THE JUNCTION TRANSISTOR. BASIC OPERATING MODE.

M.K.Achuthan.  
Electronic Technol., Vol. 37, No. 6, 236-40 (June, 1960).  
Briefly discusses the small-signal amplification properties of the common-base and common-collector stages in relation to those of the common-emitter circuit with feedback. Analogies with valve circuits are referred to.

F.F.Roberts

621.382.333 : 621.385.3

# THE PROOF OF THE COMPLETE ANALOGY BETWEEN TRANSISTOR AND TRIODE.

H.Tigler.  
Elektronik, Vol. 9, No. 3, 79-81 (March, 1960). In German.  
A perfect analogy between a junction transistor and a high- $\mu$  triode, driven into grid current, is claimed, supported by a large

number of current-voltage characteristics for both devices; common-base transistor is compared with grounded-grid triode, and common-emitter transistor with grounded-cathode triode.

A. Landman

621.382.333

**BASE SPREADING RESISTANCE OF ALLOY JUNCTION TRANSISTOR.** T. Sugano.

J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 280-5 (March, 1960). In Japanese.

The base spreading-resistance of an alloy junction transistor in the low-frequency range is calculated for an idealized model of flat-disc type, with ring base electrode round the edge and circular emitter and collector electrodes on the two faces. The results are confirmed by experiment and furnish useful design data.

A. Wilkinson

621.382.333

**EFFECT OF EXTERNAL BASE AND EMITTER RESISTORS ON NOISE FIGURE.** J.W. Halligan.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 936-7 (May, 1960).

An expression is given which takes account of the noise generated by the base bias resistance and by an unbypassed emitter resistance in a common-emitter stage, "1/f" and high-frequency noise contributions being neglected. Curves show how for a typical transistor the two resistances degrade the noise figure and modify the optimum source resistance.

F.F. Roberts

## PHOTOELECTRIC DEVICES

621.383 : 621.397.62

**USE OF PHOTO-RESISTORS IN AUTO-CONTROL OF BRIGHTNESS IN TV RECEIVERS.** See Abstr. 5255

621.383.27 : 621.317.61

**MEASURING THE SPEED OF RESPONSE OF THE 56 AVP PHOTOMULTIPLIER.**

Electronic Applic., Vol. 19, No. 3, 121-8 (1958-59).

Attempts were made to measure the deviations from isochronism of the 56 AVP photomultiplier and to ascertain the contribution made to these deviations both by the optical system and by the multiplier itself. The method of measurement is described. Results relating to the 56 AVP photomultiplier are given, and also an approximate estimate of the degree of accuracy which can be achieved with this multiplier in the measurement of time when used in conjunction with scintillators.

621.383.27 : 537.33

**PHOTOMULTIPLIER DEVELOPMENTS.**

5688 Nucleonics, Vol. 18, No. 5, 90-1 (May, 1960).

A review of papers presented at the 1960 Scintillator Counter Symposium in Washington. Tubes have been developed for high temperature operation using silver-magnesium dynodes operating at high voltage. Other tubes have short rise times ( $\sim 2$   $\mu$ sec) or very high signal-to-noise ratios.

R.D. Smith

621.383.8 : 537.3

**SOLAR BATTERIES.**

5689 A.F. Daniel.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 636-41 (April, 1960).

A short summary is provided of the applications of solar cells in satellites. A discussion of the apparent reliability and efficiency of solar cells in operating situations and the environmental factors affecting solar cells is presented. A brief discussion is also given of the various methods of mounting solar cells with succinct comments on the advantages and disadvantages of different methods. Reference is also made to quality control methods and the quality versus cost problem. A detailed discussion is given of energy-conversion devices which employ static methods for direct conversion of solar energy to electrical energy; i.e., those types which utilize the thermoelectric, Edison (thermionic emission), photo-voltaic and photoemission effects. The relative merits of these systems based on present and anticipated conversion efficiencies are reviewed.

## PARTICLE ACCELERATORS

621.384 : 621.455 : 537.56

**A COMPARISON OF ION AND PLASMA PROPULSION.**

See Abstr. 5303

621.384 : 621.455 : 525

**COMPARISON OF CHEMICAL AND ELECTRIC PROPULSION SYSTEMS FOR INTERPLANETARY TRAVEL.** See Abstr. 5302

## ELECTRON TUBES

621.385.032.213.13 : 539.2 : 537.2

**THE CONDUCTIVITY OF OXIDE CATHODES.**

**IX. THERMO-ELECTRIC POWER.**

5690

G.H. Metson and M.F. Holmes.

Proc. Inst. Elect. Engrs, Monogr. 397E, publ. Sept., 1960, 10 pp. To be republished in Part C.

For Pt VIII, see Abstr. 894 of 1960. The thermoelectric power of an oxide cathode has been examined by Young [Abstr. 225A of 1953; J. appl. Phys., Vol. 23, 1129-38 (Oct., 1952)], who finds it to be a complex function of temperature, dependent on the dual nature of oxide-cathode conductivity. By an experimental artifice the present authors show that an apparently complex form of behaviour is, in fact, the result of the superposition of two quite simple phenomena. Two parallel-acting thermoelectric power functions are involved, and each of these is invariant with temperature and temperature gradient. The two functions are physically separated and each is measured over an appropriate temperature range. The larger function, of magnitude 2.0-3.0 mV/degC, is associated with the vacuum movement of electrons through the hollow pores of the oxide matrix; the smaller one, of magnitude 0.5 mV/degC, occurs in the chains of contiguous solid particles of the matrix. Owing to the parallel connection and inequality of these functions, it is concluded that a temperature gradient through an oxide matrix leads to a continuous circulation of current, vacuum-wise in one direction and solid-wise in the other. Since the larger function is essentially one involving thermionic emission of electrons in a vacuum, it can be satisfactorily explained in terms of Richardson's law.

621.385.032.213.13 : 621.317.332.1 : 537.533 : 537.7

**NEW METHOD FOR THE MEASUREMENT OF CATHODE INTERFACE IMPEDANCE.** See Abstr. 5490

621.385.1

**NOMOGRAPHS SIMPLIFY ELECTRON TUBE DESIGN.** I-II. R.D. Reichert.

5691

Electronic Industr., Vol. 19, No. 1, 73-6 (Jan.); No. 2, 80-4 (Feb., 1960).

Three nomographs are given, by means of which the physical characteristics of a new tube may be determined quickly from the known specifications of another similar tube. Pt I details the theory leading to the production of the nomographs with reference to normal operation of diodes, triodes and pentodes. Other phenomena arising from the close electrode spacing of modern tubes are considered. The nomographs and the equations upon which they are based are valid over only a limited range and it is assumed that the tube being designed is in the same general class as the original tube from which the basic data is obtained. Pt II details the use of the nomographs with step-by-step sample solutions for a diode and a triode.

B. Dunford

621.385.1

**PARASITIC RESONANCES IN TUBES AT ULTRA-HIGH FREQUENCIES.**

5692

Electronic Applic., Vol. 20, No. 1, 24-40 (1959-60).

At ultra-high frequencies the operation of electron tubes is occasionally upset due to the occurrence of parasitic resonance of the tube components. Although the oscillatory condition is apparently satisfied, oscillation may become poor or even cease completely. To investigate the influence of the geometry of the tube components, admittance curves of various experimental electrode systems were plotted on Smith charts. These curves revealed the cause of these resonances, and led to constructional measures which eliminate this trouble.



- 621.385.1  
5693 THE CONDUCTIVITY OF OXIDE CATHODES. VIII. CURRENT-DEPENDENT MATRIX DISSOCIATION. G.H. Metson and E. McCartney. Proc. Instn. Elect. Engrs, Monogr. 357 E, publ. Feb., 1960 (Vol. 107C, 156-62, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 894 of 1960.
- 621.385.1  
5694 AMPLITUDE DISTRIBUTION OF SHOT NOISE. E.N. Gilbert and H.O. Pollak. Bell. Syst. tech. J., Vol. 39, No. 2, 333-50 (March, 1960).  
A shot noise,  $I(t)$ , is a superposition of impulses occurring at random Poisson distributed times  $\dots, t_{-1}, t_0, t_1, t_2, \dots$ . In the simplest case, if the impulses all have the same shape  $F(t)$ , then  $I(t) = \sum_i F(t - t_i)$ . The paper studies, in this and more general cases, the distribution function  $Q(I) = \Pr\{I(t) \leq I\}$ . One of the results is an integral equation for  $Q(I)$ . This yields explicit expressions for  $Q(I)$  in a number of cases, including  $F(t) = e^{-t}$ ; it also permits a computational technique which is applied to  $F(t) = e^{-t} \sin \omega t$  for  $\omega \gg 1$ .
- 621.385.3  
CROSS-WOUND GRIDS FOR MODERN PLANAR TRIODES. 5695 A. Weissfloch. Feinwerktechnik, Vol. 63, No. 9(1959). Reprinted in: Entwicklungsber. Siemens and Halske, Vol. 22, No. 4, 361-4 (Dec., 1959). In German.  
Describes the technique of preparing mesh grids by crossed windings. Gold brazing is used which makes each joint solid and also coats the wires. A.H.W. Beck
- 621.385.3  
DISK-SEAL TRIODES FOR UP TO 7 kMc/s. 5696 H. Blume and A. Hinkeldey. Siemens-Z., Vol. 33, No. 11, 723-8 (Nov., 1959). In German.  
The growing demand for communication channels makes it essential to secure transmission paths higher and higher up in the spectrum. For the generation and amplification of such frequencies recourse is taken to disk-seal triodes in the form of transit-time tubes and space-charge-controlled tubes. Decisive factors for the improvement of these tubes were the use of a metal capillary cathode, a cross-lateral grid, and aluminium-oxide ceramics as a construction material. The structural layout and fabrication of RH6C and RH7C disk-seal triodes for frequencies up to about 7 kMc/s, and their application and electrical characteristics are described. The power output of the RH6C tube at 6 kMc/s is 1.8 watts with an anode efficiency of 7.5%. As a frequency multiplier the tube operates at up to 9 kMc/s.
- 621.385.3.029.64  
AN EXPERIMENTAL DISK-SEAL TRIODE FOR 5697 6000 Mc/s. M.T. Vlaardingerbroek. Philips tech. Rev., Vol. 21, No. 6, 167-72 (1959-60).  
Brief description of an experimental disk-seal triode for 5 cm waves. The cathode-grid spacing is smaller than in the EC 157 and is achieved by pre-assembling these electrodes and adjusting the spacing in a precision jig. It amounts to about 25  $\mu$  with hot cathode. At a grid-anode spacing of 250  $\mu$ , made possible by reducing the outer dimensions of the anode resonant cavity, and at an anode voltage of 250 V, the highest tunable frequency of the amplifier designed round this valve is more than 6500 Mc/s; with 300  $\mu$  and a somewhat higher anode voltage it is more than 7000 Mc/s. With an average valve in this amplifier the product of power gain and bandwidth is 1000 to 2000 Mc/s. At 6000 Mc/s and a bandwidth of 100 Mc/s the power output is 1.5 W and the gain 7 dB. The losses amount to 15 to 20% of the output.
- 621.385.4  
A HIGH-PERFORMANCE TETRODE FOR TH RADIO 5698 RELAY. T.E. Talpey and N.C. Wittwer. Bell Lab. Record, Vol. 38, No. 2, 64-7 (Feb., 1960).  
The tetrode described is the latest of a series of high performance tubes that take advantage of the very close element spacings obtainable with frame-type control grids. The control grid-screen spacing is 0.014 inch whilst the anode is critically spaced from the screen to suppress secondary emission. Considerable attention was paid to the positioning of the base pins and connecting leads to minimize the loading effects of cathode-lead inductance and the feedback capacitance between anode and control grid. The tube has a transconductance of 31500  $\mu$ mho at an anode current of 24.9 mA and a practical gain-bandwidth figure-of-merit of 300 Mc/s is quoted. B. Dunford
- 621.385.623.5  
ON THE LARGE-SIGNAL ASPECT OF THE BROAD-BAND MULTICAVITY KLYSTRON PROBLEM-THEORY AND EXPERIMENT. S.V. Yadavalli. Proc. Inst. Radio Engrs, Vol. 48, No. 5, 953-4 (May, 1960).  
A broadband design was arrived at by using small-signal theory for all but the penultimate cavity, where a modified Webster solution is used. Measured curves agreed well with the theory. A.H.W. Beck
- 621.385.624  
CIRCULAR RESONATOR FOR A RADIAL KLYSTRON. 5700 A.I. Tereshchenko and V.I. Mil'ko. Zh. tekhn. Fiz., Vol. 29, No. 11, 1415-17 (Nov., 1959). In Russian. English translation in: Soviet Physics - Technical Physics (New York), Vol. 4, No. 11, 1305-7 (May, 1960).  
The resonator is formed by deforming a piece of ridged waveguide into a circle. Approximate formulae, valid for specified ranges of aspect ratio, for the wavelength and Q are given. These agree well with experiment. A.H.W. Beck
- 621.385.633.1  
ON THE START OSCILLATION OF THE O-TYPE BACKWARD WAVE OSCILLATOR. C.L. Tang. Proc. Inst. Radio Engrs, Vol. 48, No. 5, 947-8 (May, 1960).  
The start-oscillation frequency condition of a matched backward-wave oscillator is considered. Curves are presented showing the separate results of Heffner and of Gould as well as those obtained on the I.B.M. 650 computer. Differences are commented upon and the conclusion is drawn, on purely intuitive grounds, that the I.B.M. 650 result is the most reasonable. H.L. Natrass
- 621.385.64 : 537.533  
STATISTICAL EQUILIBRIUM OF AN ELECTRON SPACE-CHARGE WITH CYLINDRICAL SYMMETRY IN A MAGNETRON VALVE. J. Coste and L. Dagens. C.R. Acad. Sci (Paris), Vol. 250, No. 16, 3009-11 (May 2, 1960). In French.  
The method of the most probable phase distribution is applied to the cut-off magnetron with zero emission velocity. Numerical integrations giving the space-charge density in the case of vanishing cathode diameter have been performed and an example is plotted. A.H.W. Beck
- 621.385.64  
MODERN TRENDS IN MAGNETRON DESIGN. 5703 A.H. Pickering. Electronic Technol., Vol. 37, No. 6, 234-7 (June, 1960).  
A review is made of current development in this country. The major emphasis is on high peak power output tubes with low "missing-pulse" rates and satisfactory lives. Tubes have been developed using anodes with a much greater axial length than previously and without mode-locking straps. The performance of these tubes compares favourably with equivalent klystrons, and operating lives of over 10 000 hr are reported. Brief mention is made of some other recent development work on magnetrons. B. Dunford
- 621.385.83  
IMAGE CONVERTORS. APPLICATIONS IN ULTRA-HIGH-SPEED PHOTOGRAPHY. R. Galinaro. Onde elect., Vol. 39, 863-8 (Nov., 1959). In French.  
Succinct account of design and characteristics of image convertors is followed by details of the use of a Mullard triode ME 1201: the system uses two thyatrons for control of exposure time ( $\geq 10^{-7}$  seconds); the resolution is about 100  $\mu$  over the whole screen. B. Meltzer
- 621.385.833  
IN RECORDING AND STORING DATA. ELECTRON GUN FINDS NEW ROLES. R.G. Stranix. Electronic Industr., Vol. 19, No. 3, 164-78 (March, 1960).  
Semi-popular account of principles of operation and recent developments of storage tubes (recording and barrier grid), display tubes, image orthicons, vidicons and cathode-ray tubes. The use of  $2 \times 10^{-6}$  in. thick magnesium oxide targets in image orthicons is discussed. B. Meltzer

- 5706 **ASTIGMATISM IN CATHODE RAY TUBES.** 621.385.832  
N.Patia.  
J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 1, 31-7 (Dec., 1959).  
A new precise method for the observation of astigmatism in cathode-ray tubes to within  $\pm 5V$  is described. A pulsating circular trace is made to appear on the fluorescent screen of the tube. The peak cathode-current is first fixed with the normal raster, followed by switching over to the pulsating circular trace. The variation of the focus voltage now causes a very sensitive and significant change in the definition of the circumferential trace width along the XX' and YY' axes which in turn gives a measure of this parameter. A brief description of the electronic circuits along with the outline of operation is also given.

- 5707 **THE EFFECT OF THE COMPOSITION OF SETTLING LIQUIDS ON THE ADHESION OF CATHODE RAY TUBE.** 621.385.832  
I. Hango and G. Possay.  
Acta tech. Hungar., Vol. 26, No. 1-2, 155-66 (1960).  
The wet adhesion of cathode-ray tube screens as a function of the composition of the settling liquid and settling time was investigated for potassium water-glass binder and  $Sr(NO_3)_2$ . An apparatus for the series measurement of wet adhesion was described. The accuracy of the apparatus was  $\pm 3\%$ . According to the experiments the wet adhesion of screens increases with increasing settling time, and increases with increasing coagulator concentration in the settling liquid. With increasing  $SiO_2$  concentration in the settling liquid the wet adhesion increases till the  $SiO_2$  concentration reaches 0.8 g/l but decreases with further increase in the  $SiO_2$  concentration. With increasing  $SiO_2/K_2O$  content of the water glass, but with otherwise identical settling-liquid composition, the wet adhesion decreases.

- 5708 **PARTITION NOISE IN ELECTRON BEAMS AT MICROWAVE FREQUENCIES.** 621.385.833 : 537.533  
A. Ashkin and L.D. White.  
J. appl. Phys., Vol. 31, No. 8, 1351-7 (Aug., 1960).  
A study was made at 4080 Mc/s of the partition noise introduced into a beam by a meshed grid as a function of its position along the beam. Simultaneous information concerning the beam dynamics was obtained by means of a beam analyser. With cathode magnetic fields somewhat below those corresponding to immersed flow, the partition noise exhibited sharp dips as the grid in moving along the beam passed through the planes which corresponded to image planes of the cathode. These observations confirm the picture of noise smoothing taking place over relatively small areas in the vicinity of the cathode and elucidate the contribution of the random interception of electrons to the partition noise. With small cathode magnetic fields the partition noise varied sinusoidally with the cyclotron periodicity as the grid was moved along the beam. This variation with position is thought to result from the contribution to the partition noise of higher-order mode conversion.

## GAS DISCHARGES

### GAS-DISCHARGE TUBES

- 5709 **A STUDY, WITH EXPERIMENTAL TESTS, OF A HOT-CATHODE GAS-FILLED DIODE FOR H.F. INTERRUPTION.** 621.387 : 537.52  
J. Godart.  
C.R. Acad. Sci. (Paris), Vol. 250, No. 20, 3299-301 (May 16, 1960). In French.  
A brief note on a hot-cathode diode for the replacement of T.R. switches. Graphical data on insertion losses, band-width, etc., are presented.  
J.D. Cragg

- 5710 **HIGH-SPEED GAS TUBES FOR SWITCHING.** 621.387 : 621.395.65  
A.H. Beck and T.M. Jackson.  
Elect. Commun., Vol. 35, No. 4, 251-60 (1959).  
Describes a series of special gas tubes developed for telephone and telegraph switching during the period 1947-1957. These include multielectrode counters, hydrogen-filled trigger tubes, a special tube for use as a speech channel in crossbar exchanges and miniature trigger tubes for operation at megacycle speeds. A.H.W. Beck

- 5711 **EFFECT OF MAGNETIC FIELD ON MICROWAVE NOISE IN GLOW-DISCHARGE TUBES.** 621.387 : 621.327.534  
T. Hayashi.  
J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 305-10 (March, 1960). In Japanese.

When external magnetic fields are applied to fluorescent lamps, Na discharge tubes and Ne discharge tubes at various gas pressures, resonance phenomena are found in 4000 Mc/s noise outputs at nearly 1470 G in each case, which value equals that for cyclotron resonance of free electrons at 4000 Mc/s. Using a double-probe method in a Na discharge tube, electron temperatures at various magnetic-flux densities were measured, but no remarkable changes in electron temperature were observed with external magnetic fields ranging up to 2700 G. It is concluded that the noise at resonance is partly due to the deceleration of electrons at each collision, and partly to cycloidal motion of the electrons between consecutive collisions, the former corresponding to the normal noise depending on the electron temperature and the latter to the "excess" noise at resonance. A formula is deduced for the power spectrum density of this "excess" noise. For the resonance lines of noise measured on Ne discharge tubes, the mean free times of the electrons were calculated from the cyclotron resonance curves of microwave noise and shown to be inversely proportional to the gas pressures.  
A. Wilkinson

- 5712 **THE ONSET TIME OF THE DISCHARGE IN A GAS-DISCHARGE MANOMETER.** 621.387  
A.S. Borodkin.  
Zh. tekhn. Fiz., Vol. 30, No. 3, 359-64 (March, 1960). In Russian.  
Shows experimentally that the statistical distribution function of these onset times has a maximum. Two experimental tubes with non-ferromagnetic electrode configurations and dimensions (illustrated) were sealed off after usual degassing with ionization manometric valves and placed in the magnetic field of an armoured solenoid. Residual gas pressure could be increased by heating a metal detail or decreased by atomizing a getter. The position of the maximum is shown as a function of the voltage in the discharge gap and of the gas pressure. The mean development time in the pressure range  $7 \times 10^{-3} - 10^{-2}$  mm Hg is roughly in inverse proportion to the pressure.  
D.E. Brown

- 621.387.4 : 621.317.794 : 539.1.07  
**LARGE AREA GERMANIUM SURFACE-BARRIER COUNTERS.**  
See Abstr. 5531

- 621.387.424 : 621.317.794 : 539.1.07 : 525  
**RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES.** See Abstr. 5530

## ELECTRONIC EQUIPMENT

- 5713 **DETERMINATION OF THE WORK FACTOR OF AN ELECTRONIC PLANT.** 621.389  
L. Bardane.  
Automatisme, Vol. 5, No. 5, 184-6 (May, 1960). In French.  
A study of the efficiency of an electronically controlled production plant from the point of view of percentage useful operating time. The total available working hours are considered as made up of the following periods: net production time, trials periods, time spent in demonstrations and the like, time lost due to internal and external faults, time lost within the duty cycle of the equipment, maintenance and repair periods and the like. The practical significance of the individual factors is discussed and it is finally suggested that, accepting certain causes of inactive time as inevitable, the time factor of such a plant should be of the order of 90% over a period of a month.  
H.G.M. Spratt

- 5714 **UTILIZED NUCLEONIC EQUIPMENT.** 621.389  
D.R. Trotman.  
Brit. Commun. and Electronics, Vol. 7, No. 6, 420-4 (June, 1960).  
Describes an adaptation of an idea which originated in Saclay, France. The mechanical aspect has been further developed. This consists of a new shelf unit with better flexibility and good ventilation. The width of each shelf unit just fills a standard 19 in. rack and accommodates five units (modules) side by side edgewise. Heat baffles duct the hot air away from the upper modules. The basic size of a module is  $3\frac{1}{2} \times 7 \times 12$  in. The temperature within

the rack does not exceed  $10^{\circ}\text{C}$  above ambient up to ambients of  $45^{\circ}\text{C}$ . Instead of putting several stages of a circuit on one chassis, each stage is contained in a separate module. A number of units are described with circuit diagrams and photos, e.g. cathode-follower unit, head amplifier, low-level amplifier etc. Five references.

B.B.Austin

621.389

#### 5715 RADIATION EFFECTS ON ELECTRONIC SYSTEMS.

J.H. Levine and W.F. Ekern.  
Electronics, Vol. 33, No. 17, 69-72 (April 22, 1960).

Reports results of neutron and gamma irradiation of radio-communication equipment. Communication receivers withstood neutron fluxes of the order of  $10^{13}$  n/cm<sup>2</sup> without failure. The components most likely to fail under these conditions were the semiconductor diodes.

A.E.I. Research Laboratory

621.389

#### 5716 RADIATION AND ELECTRONIC DESIGN.

P. Barratt.  
Nuclear Engng, Vol. 5, 251-4 (June, 1960).

Electronic equipment, such as a television camera intended for examining a fuel channel, is subjected to severe radiation in an operating reactor. The type of damage that may be encountered in this way is dealt with and the materials that must be selected to minimize the effects of radiation are described. In general, as beta and fission fragments are easily stopped, their effects are superficial; the significant radiations are neutrons and gamma photons, both of which produce ionization. Neutrons not only disturb the electronic structure of materials, but also cause important effects on the atomic and molecular scales. In the case of organic materials, ionization leads to disruption of chemical bonds, leaving free radicals which may recombine in different ways so that gas evolution may result or materials in contact with the susceptible compound may be attacked by corrosive products. The susceptibility of different types of materials to radiation damage is summarized, and the behaviour of various electronic components — capacitors, resistors, valves, quartz crystals, transformers, dry cells, semiconductors, insulated wiring, glasses and lubricants — is described. It is concluded that high level radiation fields do not prohibit the use of complex electronic equipment as long as it is properly designed, and a life of hundreds of hours can be anticipated. Furthermore, the units are not necessarily expendable and maintenance can be envisaged.

H.A. Miller

621.389

#### 5717 SEMICONDUCTOR NETWORKS FOR MICRO-ELECTRONICS.

J.W. Lathrop, R.E. Lee and C.E. Phipps.  
Electronics, Vol. 33, No. 20, 69-78 (May 13, 1960).

Reviews the concept of "solid circuit" semiconductor networks and discusses why they should provide better reliability in addition to smaller size and ultimate savings in equipment cost. Describes how a circuit is developed from a diagram to a network on and within a semiconductor wafer. By combining oxide masking, diffusion, metal deposition, alloying and surface shaping, complex networks are fabricated using single-crystal semiconductor wafers for both active and passive components. These circuits are in pilot production with techniques much the same as used for the production of mesa-type transistors. Fabrication techniques are discussed for resistors, capacitors, diodes and transistors. The end product is a hermetically sealed unit containing a logic element which may be packaged at a final density  $\sim 8 \times 10^5$  parts/ft<sup>2</sup>.

D.J. Truslove

621.389

#### 5718 N.A.S.A. AND INDUSTRIAL PROPERTY.

H. Hurvitz.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 451-7 (April, 1960).

The purposes and powers of the National Aeronautics and Space Act are described briefly, particularly as they affect the electronics industry, as an introduction to a more extended discussion of the provisions of the Act relating to patent rights and rights to trade secrets and proprietary information generally. The stringent nature of the latter provisions is stressed, and adverse effects of strict construction and enforcement on the electronics industry analysed. Mitigating regulations under which the Act will in fact be administered are discussed.

621.389

#### 5719 AN INERTIAL GUIDANCE SYSTEM FIELD TEST PROGRAM FOR A BALLISTIC MISSILE WEAPON SYSTEM.

R.J. Slifka.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 554-7 (April, 1960).

#### RADIATIVE COOLING OF SATELLITE-BORNE ELECTRONIC COMPONENTS.

J.R. Jenness, Jr.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 641-3 (April, 1960).

The basic principles of radiative cooling of electronic components and subassemblies in a satellite are discussed, and estimates are made of the lowest temperatures attainable in a satellite by completely passive means. It appears feasible to maintain some compartments within a satellite at temperatures of  $250^{\circ}\text{K}$  or lower so an opportunity is presented for refrigerating components whose characteristics are enhanced at lower temperatures.

621.389

#### 5721 CHECKOUT AND COUNTDOWN OF THE LARGER SPACE PROBE MISSILES.

W.O. Campbell.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 728-34 (April, 1960).

While it is obvious that missiles for different space programmes carry widely different electronic equipment, it is not so apparent that missiles on the same programme may carry just as wide a variety of equipment. Checkout and countdown equipment must be versatile, not only because of the variety of electronic airborne equipment, but because of the special needs of research and development programmes and for follow-on programmes. Moreover, the equipment must offer a high level of performance reliability, so that the operator may concentrate on firing the missile. The design of the centrally programmed checkout and countdown set presented incorporates digital techniques. The punched tape supplies those commands that are subject to frequent change, such as go-no-go limits and mode and range commands for the parameter converters. Manual operation and visual evaluation are possible. These provisions also raise follow-on utility. Use of the design criteria of self-verification at every step, positive malfunction localization, standby verification and design simplicity yield a design with a high level of performance reliability.

621.389

#### MICROMINIATURIZATION OF ELECTRIC EQUIPMENT.

G.W.A. Dummer.  
Research, Vol. 3, No. 5, 187-92 (May, 1960).

The use of transistors and sub-miniature components with printed bands has reduced this form of construction to almost the ultimate. Even so, because of cooling, withdrawal space and accessibility for repairs, the packaging efficiency is only about 25%. New methods enable evaporating methods to be used giving extremely thin films of resistive material etc. Three methods, micromodule, micro-circuit and solid circuit are described. The packaging density of components per cubic foot for normal valve construction is 1000-5000, for transistor with sub-miniature components  $50 \times 10^5$  to  $60 \times 10^5$  and for solid circuit construction  $30 \times 10^5$  to  $50 \times 10^5$ . In micromodule, film components are used on ceramic or glass plates 0.3 in.  $\times$  0.3 in.  $\times$  .01 in. thick. These microelements are stacked one above the other and connected together by "riser" wires. In the micro-circuit system a complete circuit is made on a small plate about  $\frac{1}{2}$  in.  $\times$   $\frac{1}{2}$  in. The solid circuit is the most promising long-term technique. The basic principle is to form the circuit components out of a solid block of silicon. By suitably shaping the block, isolation may be obtained between the circuit elements so that there are no end connections between the various component functions. The various techniques for forming the components in each of the methods are described and illustrated with photos and diagrams.

B.B.Austin

## MEDICAL ELECTRONICS

#### PRESENT TRENDS AND LINES OF DEVELOPMENT IN MEDICAL ELECTRONICS.

M. von Ardenne.  
Nachrichtentechnik, Vol. 9, No. 10, 442-8 (Oct., 1959). In German.

A review of the whole field of electronics applied to medicine is given, with key references. The material is presented in tabular form under headings: Biological Measurement and Recording; Electro Stimulation; Ultrasonics; Radiology; Electric Apparatus, etc. Some recent topics commented on are "radio pills", heart stimulators, ultrasonic echo devices, automatic blood counters and computers applied to diagnosis using a "central library" record of symptoms.

F.T. Farmer

621.389



- 621.389 : 621.398  
5724 THE MEASUREMENT OF PHYSIOLOGICAL FACTORS FOR A PERSON UNDERGOING VIGOROUS PHYSICAL EXERCISE. W.Nicolai.

Elektronik, Vol. 9, No. 1, 5-11 (Jan., 1960). In German.

The problem of telemetering of e.c.g. and other information during vigorous exercise, e.g. running, is discussed. Electrodes for e.c.g. measurements must be kept close to the heart to avoid other muscle potentials, and the leads to the pre-amplifier short; but unwanted pick-up remains a serious problem. Radio methods, using freq. modulation, are described briefly and some typical recordings are given. The unit to be carried weighs approx. 440 g.

F.T.Farmer

- 621.389 : 681.142  
5725 RESPIRATORY CONTROL OF HEART RATE: LAWS DERIVED FROM ANALOG COMPUTER SIMULATION.

M.Clynes.

I.R.E. Trans Med. Electronics, Vol. ME-7, No. 1, 2-14 (Jan., 1960).

Heart-beat rate is extremely sensitive to, and responds very rapidly to, changes in body function e.g. breathing. An analogue computer is devised to represent the heart/lung system, which enables pulse rate to be predicted from respiration. The computer then gives with "remarkable accuracy" the times of heart beats for a variety of modes of breathing and under the effect of certain drugs.

F.T.Farmer

- 621.389 : 621.317.39  
5726 THE CONTINUOUS AUTOMATIC MEASUREMENT OF BLOOD PRESSURE USING A CONTROL SYSTEM.

H.J.v.Wilmowsky.

Regelungstechnik, Vol. 7, No. 12, 427-33 (Dec., 1959). In German.

Describes a system for automatically measuring the human blood pressure based upon the usual bloodless sphygmomanometric method using the Riva-Rocci cuff technique. The principle of this method is as follows: the control criterion is the artery signal detectable in the elbow bend: the cuff pressure is controlled in such a way that it equals either the diastolic or the systolic blood pressure. The stability conditions of a control loop of this kind are studied. The procedure for measuring the diastolic pressure can be such that a pressure transducer picks up the pulsatory pressure variations, the signals then passing through a distortion eliminator so that they give a true picture of the actual blood pressure fluctuations. In this way it is possible to obtain as output from the pressure measuring device the diastolic pressure and, by superimposing the blood pressure fluctuations, the systolic pressure as well.

621.389 : 621.395.625.3

- 5727 POSSIBLE APPROACHES TO MULTIPLE-CHANNEL TAPE RECORDING FOR BIOMEDICAL PURPOSES.

D.H.Smith, R.Moore and J.Brault.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 171-4 (Sept., 1959).

Storage of information on magnetic tapes costs only about 1/5 of photographic or hot stylus methods. The data moreover remain "live" for subsequent use. A large number of channels may be ob-

tained by multiplex systems or sub-carrier modulation frequencies and the latter is the method preferred for most biological purposes.

F.T.Farmer

- 621.389 : 621.397.9  
5728 THE ULTRA-VIOLET FLYING SPOT TELEVISION MICROSCOPE. P.O'B.Montgomery and W.A.Bonner.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 186-9 (Sept., 1959).

The u.v. light from a scanning tube is focussed by a reflection microscope on to the specimen. The transmitted light is picked up by a photomultiplier tube and the output signal is displayed on a c.r.t. with the same scanning raster. A further tube serves for photography. The repetition rate can be varied widely and the system has the advantage of allowing time for biological recovery so that living cells can be studied without damage over long periods, e.g. throughout the mitotic cycle. Provision is made for brightening a small selected area of the u. v. scanning tube in order to irradiate intensely any portion of the specimen down to  $1 \mu$  size, so that radiation damage to parts of a cell can be studied.

F.T.Farmer

- 621.389 : 621.397.9  
5729 TV TRACKER RECORDS EYE FOCUS POINTS.

E.L.Thomas, R.Howat and N.H.Mackworth.

Electronics, Vol. 33, No. 17, 57-9 (April 22, 1960).

The corneal reflection, the reflection of light from eye surface, is here investigated by making use of two TV cameras. Their respective outputs yield the picture of (a) the observed object and (b) the bright spot which represents the position of gaze of the viewer. The very concentrated light beam which falls on the viewer's eye does not interfere with vision for most of the light is reflected back to the camera. High sensitivity is achieved by a 100 times amplification in the camera which deals with the corneal reflection. Signals from the two cameras are electronically mixed and then presented on the screen which is viewed by the investigator. The system of photocells is mounted behind the screen and registers the gaze spot movements and records them in coded form for further interpretation. The circuit diagram of the cascaded one-shot multivibrators which form the coding system is given.

S.A.Kemura

- 621.389 : 621.317.3  
5730 RADIO-SONDES FOR USE IN THE ALIMENTARY CANAL. M.vonArdenne.

Nachrichtentechnik, Vol. 9, No. 10, 449-56 (Oct., 1959). In German.

Miniature transmitters which can be swallowed and which convey information about pressure, temperature and pH throughout the alimentary canal are described. A Ni-Ca cell operates a transistor oscillator which, together with its sensing system, is enclosed in a capsule 26 mm long and 7 mm diam. Freq. modulation, derived from the characteristics of the transistor gives temperature indication. A diaphragm varying the inductance indicates pressure and an Sb electrode pH. The signal is picked up on an external receiver from which automatic recordings are taken.

F.T.Farmer

- 621.389 : 621.396.96  
SAFETY PRECAUTIONS RELATING TO INTENSE RADIO-FREQUENCY RADIATION. See Abstr. 5234

## TELECOMMUNICATION

- 5731 STATISTICS IN TELECOMMUNICATIONS WITH PARTICULAR REFERENCE TO INFORMATION THEORY. I. Cappetti.  
Electrotecnica, Vol. 47, No. 3, 166-71 (March 10, 1960). 621.391
- 5732 THE ENTROPY OF THE ITALIAN LANGUAGE AND ITS EVALUATION. R. Manfrino.  
Alta Frequenza, Vol. 29, No. 1, 4-29 (Feb., 1960). In Italian.  
Exhaustive statistical analyses and computations were made on the frequency of letters, digraphs, trigraphs and words in Italian texts on various subjects (historic, scientific and journalistic) in order to derive the asymptotic behaviour of the entropy or average information content of the symbols (letters) for the language. 621.391
- 5733 APPLICATION OF MODULAR SEQUENTIAL CIRCUITS TO SINGLE ERROR-CORRECTING P-NARY CODES. T.E. Stern and B. Friedland.  
I.R.E. Trans Inform. Theory, Vol. IT-5, No. 3, 114-23 (Sept., 1959).  
Gives systematic methods for the construction of close-packed single error-correcting multi-level codes, coders and decoders. Emphasis is laid on simplicity of construction using linear modular sequential circuits, which are generalizations of the filters described by Huffman (Abstr. 222 of 1957). The problem is formulated both in transfer-function and "state-vector" matrix form and the implications of the theory of Galois' fields as regards system realizability are considered. G.D. Sims 621.391
- 5734 A SYSTEMATIC METHOD FOR THE CONSTRUCTION OF ERROR-CORRECTING GROUP CODES. R.B. Banerji.  
Nature (London), Vol. 186, 627 (May 21, 1960).  
A systematic method of generating group codes for correcting an arbitrary set of errors involves: (1) choosing a set A of linearly independent error patterns which span the set of all error patterns to be corrected; (2) choosing a set B of two arbitrary parity check sequences to represent the first two patterns of A; (3) by modulo-two addition of members of B, generating the set of parity check sequences of all error patterns spanned by B; (4) writing down the sequences generated and also the modulo-two sums of those pairs of parity check sequences at least one of which forms an allowable error pattern by addition modulo-two with the next member of A; (5) choosing a parity check sequence outside the set generated in (4) to represent the next error pattern in A and appending this to the set B; and (6) repeating (3), (4), and (5) until all possible error patterns have been spanned. G.A. Montgomerie 621.391
- 5735 ORTHOGONAL CODES. H.F. Harmuth.  
Proc. Instn Elect. Engrs, Monogr. 369 E, publ. March, 1960 (Vol. 107C, 242-8, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 3069 of 1960. 621.391
- 5736 DEFINITIVE SIGNAL THEORY. F.H. Lange.  
Nachrichtentechnik, Vol. 9, No. 8, 379-81 (Aug., 1959). In German.  
What is distinguished here is that part of information theory which deals with the properties of signals rather than the transmission medium which carries them. The discussion centres round a diagram consisting of three rows and three columns. Various concepts of the theory such as entropy, probability, correlation factor and noise are plotted on the diagram. The columns are, respectively, three methods of representation, statistic, temporal, and spectral, while the three rows refer to linear average values or first order moments, the description of a process, mean square value and second order moments. S.C. Dunn 621.391
- 5737 NOISE RELATIONSHIPS IN REAL CORRELATION PROCESSES. K.H. Schmelovsky.  
Nachrichtentechnik, Vol. 9, No. 11, 505-6 (Nov., 1959). In German.  
Theoretical assertions in correlation theory always assume an averaging process over an arbitrarily long time; in practice this time is limited. It is shown how to calculate the signal-to-noise ratio when an autocorrelator is followed by a practical low-pass filter. S.C. Dunn 621.391
- 5738 ON THE DIFFERENCES BETWEEN NON-RECURRENT AND PERIODIC TRANSIENT PROCESSES IN LOW-PASS TRANSMISSION SYSTEMS. R. Elsner and K.H. Steiner.  
Nachrichtentech. Z. (N.T.Z.), Vol. 12, No. 12, 616-24 (Dec., 1959). In German.  
In the analogue solution of mathematical problems it is sometimes convenient to use a single pulse or step and sometimes more convenient to use the repetitive form of these waveforms. It is important to know the error introduced in using a recurrent form to discover the behaviour under non-recurrent conditions and vice versa. Formulae are derived for expressing the difference quantitatively. Both ideal and approximately practical low-pass response curves are considered and the effect of phase distortion is also taken into account. Finally, an experimental proof is described on a low-pass filter with a cut-off frequency of 2.5 kc/s. The agreement with theory is satisfactory and it is concluded that the methods are useful for determining the maximum repetition rate which may be safely employed in a given case. S.C. Dunn 621.391
- 621.391 : 621.142  
UNIVERSAL NON-LINEAR FILTER, PREDICTOR AND SIMULATOR WHICH OPTIMIZES ITSELF BY A LEARNING PROCESS. See Abstr. 5282
- ## TELEGRAPH AND TELEPHONE SYSTEMS
- 621.394.441  
5739 TRANSISTORIZED TELEGRAPH TRANSMISSION SYSTEMS. H. Bouwman and M. Karlin.  
Philips Telecomm. Rev., Vol. 21, No. 3, 114-36 (Feb., 1960).  
Describes two 24-channel systems (either a.m. or f.m.) with 120 c/s carrier spacing which can be mounted on one side of a 9 ft bay. For smaller stations, pre-wired 6-channel panels are available. Steps have been taken to counteract the influence of sudden level changes in a.m. systems, and of frequency drift in f.m. systems. Derived systems, such as an 18-channel system with a channel spacing of 170 c/s, and speech-plus-duplex systems are also described. 621.394.657
- 5740 NEW FACILITIES FOR 5-STATION TELEX SUBSCRIBERS. H.J. Machutt and H. Miemiec.  
Siemens-Z., Vol. 34, No. 4, 184-6 (April, 1960). In German.  
In dial exchange networks, subscribers with several teleprinters could hitherto be provided either with as many individual lines or with collective call numbers. In a third possibility here described, the advantages of collective numbers are combined with those of individual line connections. Any of the subscriber's teleprinters can be reached separately through dialing the respective number. If it is found busy, however, the call is rerouted to the other teleprinters in a predetermined sequence until one is found free. 621.395.2 : 621.391.827.42
- 5741 INTERMODULATION ON AMPLITUDE-MODULATED MULTI-CHANNEL LINE LINKS. J.C.H. Davis and H.C. Friedheim.  
Proc. Instn Elect. Engrs Monogr. 384 E, publ. June, 1960 (Vol. 107C, 342-52, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 5149 of 1960. 621.395.2 : 621.386
- 5742 NEW COMBINATION LUMINOUS CALL AND INTERCOMMUNICATION SYSTEM FOR HOSPITALS. W. Mirow.  
Siemens - Z., Vol. 34, No. 4, 243-4 (April, 1960). In German.  
To save nurses unnecessary walks to the bedside of patients while at the same time improving the efficiency of service given

to patients, a luminous call system has been combined with an intercom system. With the new combination system here described the patient is able to talk to the nurse over the intercom, or call her by luminous signal, depending on his condition. It is also possible to have a luminous call system installed first and combined with an intercom system later.

621.395.3 : 621.317.34

MEASURING METHODS FOR TELEPHONE INSTALLATIONS.  
See Abstr. 5496

621.395.44

5743 THE EXTENSION TO 12 Mc/s OF THE FREQUENCY BAND TRANSMITTED BY 2.6/9.5 mm COAXIAL-PAIR CABLES. F. Job and M. Toutan.

Cables et Transm., Vol. 13, No. 3, 145-56 (July, 1959). In French.

The French 2.6/9.5 mm P.T.T. cable system was designed to carry 900 channels in a 4 Mc/s band with repeaters at 9 km intervals. The system now described is designed to utilize the existing cable runs, and for this reason the repeaters spacing is now 4.5 km. Descriptions are given of the new 12 Mc/s bandwidth amplifiers, the method of monitoring their performance, and the means of their adjustment. The frequency plan conforms to C.C.I.T.T. requirements. An account is given of the generation of the necessary frequencies.

W. T. Blackband

621.395.44 : 621.315.052.63

5744 CARRIER-WAVE COMMUNICATION ON INTERCONNECTED 6kV OVERHEAD DISTRIBUTION SYSTEMS ON THE PHASE-PHASE PRINCIPLE. B. V. Smirnov and V. E. Efremov. Elekt. Stantsii, 1959, No. 8, 60-5 (Aug.). In Russian.

In the system described the communication equipment is connected to the l.v. side of the consumers' transformers and is suitable for operation in the 10-50 kc/s band, particularly if there are cable sections in the system rendering operation on higher frequencies impossible. The attenuation introduced by a single transformer is 0.1-1.8 N and increases when the load impedances on the h.v. side are reduced.

Electrical Research Association

621.395.44

5745 TRANSISTORIZED CARRIER TELEPHONE EQUIPMENT. I. L. H. Kuitjsten and F. A. Vitha. Philips Telecomm. Rev., Vol. 21, No. 4, 166-82 (April, 1960).

Description of transistorized carrier telephone equipment, comprising a 12-channel system for 2-wire circuits, a 12- or 24-channel system for radio links, and through-group equipment. Equipment size and power consumption have been reduced, while reliability has been increased. As a result, it has been possible to simplify the supervision and alarm facilities. Reduced maintenance requirements also contribute to a lowering of the overall operating cost. A new transmission measuring set has been developed for use with the transistorized equipment.

621.395.44

5746 TRANSISTORIZED CARRIER TELEPHONE EQUIPMENT. II. C. P. L. van Doveren and J. F. Lansu. Philips Telecomm. Rev., Vol. 21, No. 4, 183-93 (April, 1960).

Description of a four-wire, 60-channel repeater for straight-spliced, deloaded v.f. star-quad cables, and of a 12-channel, two-wire repeater for paired, random-spliced, deloaded v.f. cables. The effects of near-end crosstalk and of crosstalk via through v.f. circuits are eliminated by giving the repeaters a low gain, of the order of 30 dB. Low power consumption permits feeding the repeaters over the cable, avoiding regular and emergency power plant at the repeater points. Small dimensions, long transistor life and low liability to faults make it possible to put these repeaters underground and avoid the erection of special repeater buildings.

621.395.44

5747 A WIDE-BAND PHASE SHIFTER. A. A. Ahmed.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 945 (May, 1960).

Describes a method for obtaining two outputs, differing in phase by 90°, for a given signal input. The signal is mixed with a local oscillator higher than the signal frequency, and the upper sideband is selected by a filter. This upper sideband is in turn mixed in two other mixers with the original local oscillator, and one of the same frequency shifted in phase by 90°. The two lower sidebands are selected by means of filters, thus giving two outputs of the signal frequency, differing by 90° in phase.

A. C. Brown

621.395.44 : 621.382.333

5748 APPLICATION OF TRANSISTORS TO LONG DISTANCE TELEPHONY. J. van der Donck.

Rev. E, Vol. 3, No. 2, 67-78 (1960). In French.

After a general review of systems of carrier telephony the advantages gained by the introduction of transistors (improved reliability, reduced power consumption) are outlined. Applications as modulators, amplifier, frequency generators and in signalling circuits are discussed, as well as the effect on the economics of short-distance carrier systems. Future trends include the use of time-division multiplex and pulse-code modulation. The new developments should bring about the co-ordination of transmission and switching techniques.

C. Fromberg

## TELEPHONE EQUIPMENT COMMUNICATION NETWORKS AND CABLES

621.395.635

5749 ELECTRONIC TRANSLATOR FOR NATIONWIDE DIALING. F. Licht.

Siemens - Z., Vol. 34, No. 4, 173 (April, 1960). In German.

A short review is given of the problems and constructional design of a new electronic translator for central alternate routing and zoning at the junctions of long-distance dialling networks.

621.395.65 : 621.387

HIGH-SPEED GAS DISCHARGE TUBES FOR TELEPHONE AND TELEGRAPH SWITCHING. See Abstr. 5710

621.395.73 : 621.316.935

NEUTRALIZING CHOKES FOR TELEPHONE LINES ENTERING POWER STATIONS. See Abstr. 5459

621.395.74 : 621.372.8

5750 LONG-RANGE COMMUNICATIONS OVER WAVEGUIDE LINES. W. Stühr.

Siemens - Z., Vol. 33, No. 11, 685-90 (Nov., 1959). In German.

In long-range communications networks it will in due course be possible to use waveguides composed of dielectrically loaded tubes or of helix waveguides as a third transmission path alongside coaxial cable and the broadband radio path. It is likely that optical deflectors will be used. The results of measurements performed on devices for waveguide lines and on several experimental waveguide routes are given.

621.395.741

5751 OPEN-WIRE CARRIER LINES AND THEIR LEADS-INS IN REPEATER STATIONS. K. Schreiber.

Siemens - Z., Vol. 33, No. 8, 521-5 (Aug., 1959). In German.

An account is given of the factors to be considered in connection with the installation of open-wire carrier lines (crosstalk requirements, line unbalances, constructional tolerances, transposition plans). The suitable construction of lead-ins with matching equipment and lightning arresters is also described.

621.395.741 : 621.395.44

5752 POWER FEEDING ON THE CALCUTTA-ASANSOL SYMMETRICAL PAIRED CARRIER CABLES.

G. D. Dubey, U. D. N. Rao and J. Francis.

Telecommunications (Jabalpur), Vol. 8, No. 2, 83-90 (Dec., 1958).

621.395.741 : 621.395.44

5753 PROBLEM IN SINGLE PHASE POWER TRANSMISSION OVER SYMMETRICAL PAIR CARRIER CABLES.

U. D. N. Rao.

Telecommunications (Jabalpur), Vol. 8, No. 2, 91-5 (Dec., 1958).

621.395.741 : 621.395.44 : 621.315.667.1

5754 EFFECTIVE SPLICING METHODS IN CARRIER CABLES. J. W. Scholten.

Philips Telecomm. Rev., Vol. 21, No. 4, 194-6 (April, 1960).

In splices between drum lengths of carrier cables there appear to be only two fundamentally different methods of interconnecting two quads. In the first method both pairs are spliced straight through. The second method consists in crossing the conductors of one pair. This method is effective against all forms of systematic crosstalk, which means it also balances out the exchange effect.



621.395.741 : 621.315.211.4

5755 TERMINAL ACCESSORIES FOR GAS-PRESSURE  
MONITORED LONG-RANGE AND JUNCTION CABLES.

E. Kraus.

Siemens - Z., Vol. 34, No. 4, 249-50 (April, 1960). In German.

The introduction of gas-pressure monitoring for communications cable systems called for the development of new types of cable accessories. The paper treats of distributing sleeves for the pressure-tight termination of such cables. Cable entrances are provided with compression type glass-metal seals or epoxy-resin plugs, depending on the field of application.

## ELECTROACOUSTIC APPARATUS

621.395.61 : 612.8

5756 AN ENERGY THEORY OF DIRECTIONAL HEARING  
AND ITS APPLICATIONS IN STEREOPHONY.

H. Mertens.

E.B.U.Rev. A, No. 50, 22-33 (Feb., 1960).

Studies of sound diffraction around the head show that the resultant sound pressure amplitudes and phases provide directional information. Actual values are calculated, assuming the two ears to subtend an angle of  $160^\circ$  at the centre of a sphere of 21 cm diameter. The total impression at the two ears depends on both the spectral and time distribution of the sound energy at these points, but the time differences are the predominant effect at middle and low frequencies. Formulae are developed for the directional transfer function using Gabor signal theory, a Gaussian pulse being chosen as the best compromise signal for analytical purposes. The relations between the true and virtual source directions are calculated for both crossed and spaced microphone systems, the governing parameters being derived from the particular microphone arrangements used and the spacing of the two loudspeakers. The transfer function is largely independent of frequency for the crossed microphone system, but a considerable variation occurs for the spaced microphone system. This may account for the present tendency to use cardioid rather than omnidirectional microphones in order to improve low frequency discrimination in spaced microphone systems. Some experimental confirmation of the main results is given and the relation of the present work to earlier studies is discussed.

M.L. Gayford

621.395.61

5757 PERCEPTION OF THE STEREOPHONIC EFFECT AS A  
FUNCTION OF FREQUENCY.

W.H. Beaubien and H.B. Moore.

J. Audio Engng Soc., Vol. 8, No. 2, 76-86 (April, 1960).

A survey was made of stereophonic literature and 88 references are given in a bibliography. Experiments are described in which subjective tests of directional perception were made for programme material in various frequency bands. The matrixing, filter and equalizing circuits used are described in detail. It was confirmed that a high degree of directional perception exists for substantially the full audio spectrum, extreme low frequencies having at least as great a directional effect as higher frequencies. The ambiguities met with for continuous tones do not seem to exist to an appreciable extent when musical and other programmes are reproduced.

M.L. Gayford

621.395.61

5758 BROADENING THE AREA OF STEREOPHONIC  
PERCEPTION. B.B. Bauer.

J. Audio Engng Soc., Vol. 8, No. 2, 91-4 (April, 1960).

The conventional two-channel stereophonic arrangement uses two loudspeakers spaced at about 0.7 times the length of the backing wall. The performance with regard to balance, localization and the illusion of spaciousness is discussed. Particular defects are the deterioration of balance and the loss of "centre fill" for listeners who are not on the centre axis. A calculation is made of the balance achieved by taking the direct sounds radiated by loudspeakers of given polar characteristics. Two dipole loudspeakers subtending an angle of  $120^\circ$  at a point in front of the nearest central listeners are shown to give considerable broadening of the effective stereo area on the basis of a 3 dB tolerance for balance. A practical system is described using a common bass loudspeaker and two disguised angled baffle smaller loudspeakers.

M.L. Gayford

## STEREO AS AN INTEGRAL SYSTEM.

5759 N.H. Crowhurst.

J. Audio Engng Soc., Vol. 8, No. 2, 95-9 (April, 1960).

Stereophonic techniques are outlined, with particular reference to spaced, crossed, m.s. and mixed microphone techniques. Some experimental recordings were made using various spaced and crossed 2- and 3-microphone arrays. They were reproduced in various sizes of auditoria on spaced and crossed (directional) loudspeakers. It was generally considered that crossed microphones and spaced loudspeakers were best in small listening rooms whilst spaced microphones and spaced loudspeakers were best in large listening enclosures. It is suggested that the order of the size of the ultimate listening room must be established when a recording is to be made.

M.L. Gayford

621.395.61

NOMOGRAM FOR DETERMINATION OF AUDIO  
POWER IN INDOOR PUBLIC ADDRESS SYSTEM.

5760

N.K.D. Choudhury.

J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 1, 51-5 (Dec., 1959).

The acoustic power required to establish a desired sound pressure level in a room depends on the volume of the room and also on its acoustical properties. The efficiency of the loudspeaker in the sound reinforcing system is also determined, to some extent, by the room characteristics and its location in the room. Taking all these factors in consideration, a nomogram is evolved that can be readily used in assessing the electrical audio power output demanded from a public-address amplifier in the hall. A few relevant factors, such as the desired sound-pressure level, noise level in the hall, are also discussed.

621.395.61

TRANSMISSION EQUIPMENT FOR SUBSCRIBER  
TELEPHONES. O. Hörner and W. Langsdorff.

Siemens Z., Vol. 33, No. 8, 479-86 (Aug., 1959). In German.

Possible circuits for subscriber telephones and circuitry of transmitter and receiver insets are illustrated with the aid of examples. A number of transmission problems in connection with the handset are discussed.

621.395.61 : 612.8

ACOUSTIC IMPEDANCE OF HUMAN EARS AND SOME  
ARTIFICIAL EARS. I. Nábelek.

5762

Slaboproudy Obzor, Vol. 21, No. 4, 210-14 (1960). In Slovak.

The acoustic input impedance of the ears was measured by the standing-wave method by employing the Hall tube. The impedance was measured at 25 different frequencies in the range of 0.3 to 7.5 kc/s. Altogether 23 human ears were investigated: 15 left ears of males, 4 right ears of males, 2 left ears of females and 2 right ears of females. The age of the subjects was 20-33 and all the measurements were carried out at the sound level of 60-70 dB. The results of the measurements are shown in graphs; both the real and imaginary components of the impedance as a function of frequency are given. The results are compared with the impedance of the artificial ears of the C.C.I.T.T., the British General Post Office and the Italian Postal Administration. The discrepancies between the impedances of the human and the artificial ears are due to the fact that the artificial ears lack the sound resonance (at about 3 kc/s) and that a human ear never adheres very closely to a receiver.

R.S. Sidorowicz

621.395.623.84 : 534.3

SUGGESTION RELATIVE TO THE STANDARDIZATION  
OF LOUDNESS-BALANCE DATA FOR THE TELE

5763

PHONICS TDH-39 EARPHONE. J.R. Cox, Jr and R.C. Elger.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 1081-2 (Aug., 1960).

Suggested r.m.s. sound-pressure levels in N.B.S. type 9A coupler corresponding to 0 and 60 dB hearing levels are given for a Telephonics TDH-39 earphone in an MX41/AR cushion. The figures were obtained from an average of three unpublished studies which in each case involve a loudness balance with a WE705A earphone.

H.D. Parbrook

621.395.625.3

MAGNETIC STORAGE TECHNIQUE. [Technik der  
Magnetspeicher]. Edited by F. Winckel.

5764

Berlin/Göttingen/Heidelberg: Springer-Verlag (1960), xvi + 614 pp. In German.

A comprehensive work covering most of the technical aspects

and the main applications of magnetic recording on tape film, wire, disks and drums. Occasional brief references are made to magnetic-core matrices and to magnetostrictive delay lines for computers. The book is the work of thirteen authors and consists of fourteen chapters. These are as follows: (1) fundamental principles of magnetism; (2) the magnetic recording and reproducing process; (3) the Preisach model in the theory of magnetic recording; (4) making magnetic sound recordings visible; (5) the technique of magnetic recording apparatus; (6) the process of and equipment used in picture-synchronous sound recording in film and television; (7) the application of magnetic storage technique to television recording; (8) magnetic sound storage in studio work; (9) the magnetic store in electronic calculators; (10) the digital store as the building block in data-processing installations; (11) measurement technique for the magnetic store; (12) the theory of the magnetic store; (13) the manufacture and electroacoustic properties of magnetic tape-stores for sound recording; and (14) standardization of magnetic storage technique. A considerable portion of the subject matter has appeared as published papers over the last ten years. In many parts, particularly those dealing with flux evaluation and field distributions, the treatment is of a profound nature. Practical data is, however, somewhat sparse and few applications beyond those already mentioned are included. Extensive bibliographies are provided.

H.G.M.Spratt

621.395.625.3

5765 **DOUBLE-SYSTEM RECORDING AND EDITING WITH VIDEO TAPE.** O.F.Wick.

J. Soc. Motion Picture Televis. Engrs, Vol. 69, No. 3, 164-6 (March, 1960).

The technique of editing sound and picture separately, as employed in the motion-picture industry, is applied to video tape. Sound is recorded on a 16 mm sprocketed magnetic film and on the video tape while the picture is fed into the video tape recorder and to a kinescope which in turn is photographed by a 16 mm single-system video-recording camera. In addition, a master 16 mm magnetic film carrying "edit sync." signals is played throughout the recording. The edit sync. signals consist of bursts of about 40 cycles of a 3 kc/s tone at 1 sec intervals while between the bursts are identifying aural signals. The edit sync. signals are recorded on the three recorders and provide a means of locating corresponding points on the various recorders prior to splicing.

H.G.M.Spratt

621.395.625.3

5766 **MOBILE OPERATION OF THE VIDEOTAPE RECORDER.** C.F.Swisher.

J. Televis. Soc., Vol. 9, No. 5, 171-5 (Jan. - March, 1960).

Describes the construction and layout of a 35 ft mobile unit. The unit incorporates the video tape recorder, two image orthicon cameras, a sync. generator, audio equipment and ancillary apparatus. Emphasis is laid on the suspension of the vehicle and the recorder, accessibility and ventilation. The frequency stability of the power generator must be exceptionally good and various means of achieving it are described. The unit operated successfully for six months on a 17 000 mile tour under extreme temperature conditions.

H.G.M.Spratt

621.395.625.3

5767 **THE 120-I.P.S. TAPE DUPLICATOR FOR FOUR-TRACK COMMERCIAL STEREO TAPES.** R.A.Isberg.

J. Audio Engng Soc., Vol. 8, No. 2, 105-10 (April, 1960).

The 4-track tapes carry the two pairs of stereo channels interspaced on  $\frac{1}{4}$  in. tape and are recorded for playing speeds of  $7\frac{1}{2}$  and  $3\frac{3}{4}$  in./sec. The recording from one  $3\frac{3}{4}$  in. wide 15 in./sec master tape is first converted and transcribed as a 2-channel recording on a 4-track  $\frac{1}{4}$  in. tape and then a second recording is similarly transcribed on to the other two tracks. Transfer to slave tapes is finally carried out at running speeds of 120 or 60 in./sec. The response of the  $7\frac{1}{2}$  and  $3\frac{3}{4}$  in./sec tapes at 15 kc/s is 4 dB and 6 dB down respectively and care is taken in the adjustment of level and emphasis to ensure optimum dynamic range and absence of tape saturation at h.f. The salient features of the high-speed duplicating machines are described.

H.G.M.Spratt

621.395.625.3

5768 **THE TAPE-HEAD RELATIONSHIP IN MULTITRACK RECORDING.** F.Leslie.

J. Audio Engng Soc., Vol. 8, No. 2, 130-1 (April, 1960).

A comparison between multitrack and full-width recording. Due to fringing effects the l.f. response, other things being equal, is

higher than with full-width recording to the extent of 2-5 dB at 50 c/s. Crosstalk also is possible but it is more likely to arise from coupling between heads from the tape. The signal/noise ratio is degraded by about 3 dB and the effect of drop-out is more pronounced. On the other hand an error in azimuth alignment has less effect on h.f. response. If heads are staggered, great care must be taken to ensure that the longitudinal distances between corresponding pairs of record and playback heads are the same in order to avoid phase errors.

H.G.M.Spratt

621.395.625.3

5769 **THE RECORDING OF NUCLEAR PULSE DATA.** P.E.Cavanagh.

Nuclear Engng, Vol. 5, 255-7 (June, 1960).

In slow neutron spectrometry the simultaneous detection and analysis of particle energies, together with correlated phenomena, e.g.  $\gamma$ -ray emission, demands either an impractical number of channels or an unacceptable length of counting time. These drawbacks can be overcome by recording the data on slow-speed magnetic tape and subsequently playing back the record at a higher speed into the analyzer. Multitrack working enables the correlated data to be recorded. Analogue recording, i.e. "direct" recording with r.f. bias, is generally satisfactory. Digital recording, however, may be desirable when greater accuracy is required or when the original data is in digital form, e.g. pulse counts. Here, the associated equipment is more complicated and the tape speed may have to be raised.

H.G.M.Spratt

621.395.625.3 : 621.316.718.5

**TRANSISTORIZED MOTOR SPEED CONTROLS FOR SATELLITE TAPE RECORDERS.** See Abstr. 5434

## RADIOCOMMUNICATION

621.396.1

5770 **RADIO SPECTRUM CONSERVATION.** S.Sillen.

Alta Frequenza, Vol. 29, No. 1, 96-127 (Feb., 1960). In Italian.

Problems affecting the coexistence of several radio systems are considered. A brief review of international organizations and regulations dealing with coordination of radio spectrum use is given. An ideal spectrum occupation condition is presented, together with some of its practical limitations. Application of the components of this spectrum, are analysed: geographical sharing, frequency sharing (for this an ideal sharing is deduced from the Hartley-Shannon law) and time sharing.

621.396.1 : 621.311.1

5771 **RADIOCOMMUNICATION IN THE POWER INDUSTRY.** E.H.Cox and R.E.Martin.

Proc. Instn Elect. Engrs Paper 3290 S, publ. July, 1960. To be republished in Vol. 108A (1961).

Reviews the present position with regard to the uses of radio-communication by the electricity supply industry and draws attention to some of the problems which have been encountered in the planning and operation of mobile and fixed v.h.f. radio links. The subject is dealt with from a general point of view, since the wide variety of applications and special requirements cannot be dealt with in detail in a single paper.

621.396.2

5772 **THE STATISTICAL DISTRIBUTION OF DEPTHS OF FADING OVER THE INTERVALS OF RADIO RELAY SYSTEMS.** A.I.Kalinin.

Radiotekhnika, Vol. 15, No. 6, 3-9 (June, 1960). In Russian.

Obtains expressions for the integral curves of the fading depth distribution on the assumption of a normal law of distribution of the effective vertical gradients of the dielectric constant of the atmosphere; limiting expressions for the curves are also obtained. Fading is assumed to be due to interference of the direct wave and waves reflected from the earth's surface. Graphs include stability curves for routes of 40, 60 and 80 km and  $\lambda = 8$  and 16 cm (assuming the earth to be an ideally smooth sphere).

D.E.Brown

- 621.396.2  
5773 OPTIMUM DESIGN CONSIDERATIONS FOR RADIO RELAYS UTILIZING THE TROPOSPHERIC SCATTER MODE OF PROPAGATION. C.A. Parry. Trans Amer. Inst. Elect. Engrs I, Vol. 79, 71-80 (1960) = Commun. and Electronics, No. 47 (March, 1960).

The nonlinear noise introduced by truncating the bandwidth may be used as a basic factor in the analysis of the optimized multi-channel system. The ratio of signal to thermal noise may then be expressed purely as a function of traffic volume and noise bandwidth. This leads to a minimal bandwidth criterion which permits substantially greater s./n. ratio and lower transmitter power than is possible in the nonoptimized system. General expressions are developed for the optimum bandwidth as a function of s./n. ratio and traffic loading, and from these expressions, the minimum permissible transmitter power for the optimized system may be derived. An economic index is discussed which permits a comparison between links with different numbers of channels and different grades of service and reliability. Methods of reducing transmitter power by stabilizing some of the system parameters are reviewed. A new technique is described in which the bandwidth is controlled by the traffic volume, making possible a further reduction of transmitter power. A means for the greater utilization of circuits carrying light traffic loads is also considered. 53 references.

A. Wilkinson

- 621.396.4  
5774 PASSIVE SATELLITE COMMUNICATION. J.L. Ryerson. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 613-19 (April, 1960).

A number of communications capabilities are noted as desirable goals and the characteristics of passive satellite reflectors are cited as a means of achieving them. Goals noted are the attainment of transoceanic ranges, high communications traffic per satellite, low launching and operating costs, high reliability, simplicity of operation and long useful life of satellites. The properties of various types of passive reflectors are discussed and the characteristics of the sphere are shown to be particularly advantageous. Passive satellite communications systems are compared with current tropospheric scatter systems and are shown to be one order of magnitude better, using power per channel per unit range as a criterion. Some attention is given to Doppler shift as it bears upon the problem of transmitter-receiver channel coordination, satellite acquisition, and tracking.

- 621.396.4  
5775 COMMUNICATION SATELLITES. D.L. Jacoby. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 602-7 (April, 1960).

A review paper. The advantages and disadvantages are considered for various types of passive and active devices, for various orbits, and from the standpoint of both military and commercial applications. Consideration of all major technical and economic factors leads to the conclusion that a system of 3 or 4 repeater satellites in 24 hr orbits will best meet future world-wide communication requirements. A number of system concepts are described, including time-synchronous and frequency-sharing systems. Important aspects of communication satellite design are discussed including electronics, arials, power supply, structure, attitude and position stabilization, command control and telemetering. Selection of frequency is shown to be not critical over a wide range. Choice of design parameters such as power output, aerial gain, stabilization accuracy, etc., is largely dependent on the desired capacity of the communication system and the available satellite payload. Some typical parameters for a high-capacity system are presented. Reliability is an over-riding consideration in satellite design and it is proposed to achieve desired life by proper choice of components, by use of redundancy, and by minimization of satellite requirements at the expense of the ground equipment. Based on published information on A.R.P.A.-N.A.S.A. programmes and booster capabilities some estimates are made of the rate of progress which can be expected in communication satellites, leading to their eventual use in military and commercial communications. Wide application is foreseen because of increasing communication requirements which will saturate existing facilities.

- 621.396.4  
5776 INTERFERENCE AND CHANNEL ALLOCATION PROBLEMS ASSOCIATED WITH ORBITING SATELLITE COMMUNICATION RELAYS. F.E. Bond, C.R. Cahn and H.F. Meyer. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 608-12 (April, 1960).

The use of active and passive relays is considered for applica-

tion to long-distance global trunk communication, with particular emphasis on economic utilization of the media from the traffic capacity viewpoint. Active and passive techniques are compared with regard to power requirements, coverage, mutual interference, and ability to exploit wide-band modulation systems to reduce interference. With the emphasis on microwave transmission, narrow beamwidths, and a multiplicity of relays, channel allocations of the future will necessarily be determined by spatial considerations, in addition to specifying frequency bands. Examples with typical global paths and assumed active and passive systems are illustrated. It is concluded that, although a great increase in transmission capacity is forecast with the new techniques, a much broader scope of coordination will be necessary to control interference.

- 621.396.4  
5777 THE USE OF A PASSIVE SPHERICAL SATELLITE FOR COMMUNICATION AND PROPAGATION EXPERIMENTS. T.H. Vea, J.B. Day and R.T. Smith. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 620-4 (April, 1960).

The use of a passive satellite for over-the-horizon communication links has been proposed by Pierce and Kompfner (see Abstr. 3835 of 1959). To confirm the theoretical work which has been done to date, the N.A.S.A. is planning to launch an aluminium coated, 100 ft-diameter plastic sphere for such a communication relay. In addition to confirming the feasibility of a communication link, the sphere can be instrumental in confirming theoretical work in u.h.f. propagation characteristics. With regard to conducting propagation studies, an essential requirement is that the sphere's scattering properties be described in advance of the experiment. The scattering properties of a metallic sphere (whose radius is very large with respect to the wavelength of the incident radiation) are described. It is shown that the sphere's scattered field pattern is a function of the incident radiation's polarization scheme, and that the choice of any particular polarization scheme depends upon the experiment to be performed.

## TRANSMITTERS . RECEIVERS

- 621.396.61 : 621.398  
5778 TELEMETRY TRANSMITTER FOR RADIATION SATELLITE. A.J. Fisher, W.R. Talbert and W.R. Chittenden. Electronics, Vol. 33, No. 19, 68-9 (May 6, 1960).

The output power is 300 mW and the transmitter operates on a frequency of 108.03 Mc/s with a life expectancy of 12 to 18 months. A primary requirement for the transmitter was that it be disk-shaped. The oscillator output is 2 mW and driver output 39 mW. The phase-modulator circuit is a modified conventional bridged-tee network evolved from a lattice network. Its advantages, besides simplicity, are: a modulating capability of 1.5 radians with a minimum audio signal in the frequency range 400-1300 c/s; more favourable operating parameters; greater suitability to low impedance characteristics of the crystal oscillator output circuit. The network is arranged so that the important reactances are all capacitances and in particular those which need to be varied are in fact capacitor diodes which can be varied electronically. The crystal-controlled oscillator circuit uses a feedback network which excludes the crystal so that oscillator drop-out effect with tuning is avoided.

S.C. Dunn

- 621.396.61  
5779 MEASUREMENTS OF TELEGRAPH CHARACTERISTICS, FREQUENCY, SIDEBANDS AND HARMONICS ON HIGH-POWER SHORT-WAVE TRANSMITTERS. H.J. Eliassen. Fernmelde-Ingenieur, Vol. 14, No. 4, 35 pp. (April 15, 1960). In German.

Some important characteristics of radiotelegraphy are defined and discussed: the shape of the signal with various kinds of distortion, signal splitting and drooping, bandwidth used and bandwidth necessary, radiation outside the band, spectrum of frequency-modulated transmitters. Measurements of telegraph modulators are mainly concerned with automatic level control of the incoming signals and with signal distortion. Frequency measuring equipment used for frequency setting and for supervision during actual operation is based on comparison with a standard frequency obtained in a crystal-controlled oscillator. Spurious side-frequencies and their measurement are discussed. Harmonic measurements are made on dummy arials



with constant wave impedance in the range 3 to 100 Mc/s, by means of spectrum analysers or by substitution method, or else on dummy aerials which do not possess constant impedance in the range of harmonic frequencies; in the latter case reflectometers are used.

J.M.Silberstein

621.396.611

## MAKING TRANSMITTERS RFI-FREE.

5780 C.E.Blakely and R.N.Bailey.  
Electronic Industr., Vol. 19, No. 3, 132-41 (March, 1960).

Considering the two most general block diagrams of transmitters one finds that the presence of harmonics in the output has its origin in the frequency multipliers which follow the master oscillator(s). The expression for the amplitudes of the harmonics relative to the selected frequency is given. It is shown that high-Q circuits should be used for efficient suppression of undesired frequencies in the output. The other source of harmonics lies in any spurious resonance in the circuitry and results in further bands of harmonics. Four techniques are recommended for suppressing the harmonic output of a transmitter: (a) better filtering in all stages implying more tuning adjustments; (b) inclusion of filters and traps for specially undesired frequencies; (c) effective inter-stage shielding; and (d) more stages with linear operation. The causes of intermodulation, case and power-line radiation, cross-modulation and carrier noise are explored and an expression for their evaluation is included. Means for measurement and methods of attacking these troubles are quoted. There is a very extensive bibliography.

S.A.Kemura

621.396.62

## TRANSISTORS IN COMMUNITY RECEIVERS.

5781 M.V.Joshi and T.V.Ramamurti.  
J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 2, 71-6 (Feb, 1960).

Described briefly a method of stabilization of the bandpass characteristics of the h.f. stages on application of a.g.c. The complexity of the circuit technique required for this purpose and the high cost of h.f. transistors lead to a prohibitive cost of the community receiver. A hybrid design, i.e. a design utilizing both valves and transistors, is then described and it is shown that at slightly increased initial cost one can secure substantial economies in maintenance and battery replacement costs.

## RADIOFREQUENCY EQUIPMENT

621.396.662.2 : 621.382.2

## INDUCTIVE ELEMENTS FOR SOLID-STATE CIRCUITS.

5782 M.Schuller and W.W.Gartner.  
Electronics, Vol. 33, No. 17, 60-1 (April 22, 1960).

In order to replace the relatively bulky inductors, for use in microminiaturized circuits, different semiconducting effects which exhibit inductive behaviour have been investigated. The inductive property found in the diodes increases with their losses but this can be corrected by a series connection of a solid-state negative resistance. Diodes which show negative resistance are even better and approach the performance of tunnel diodes. A coilless tank circuit for  $f_0 = 1.3$  Mc/s is described. It contains a damping resistor which prevents self-oscillation of the circuit. A prototype circuit is suggested. Six references.

S.A.Kemura

## AERIALS

621.396.67

## TELEVISION ANTENNA SYSTEM MEASUREMENTS

5783 BASED ON PULSE TECHNIQUES. D.W.Peterson.  
I.R.E. Trans Broadcasting, Vol. BC-6, No. 1, 12-21 (March, 1960).

The performance of the overall aerial assemblies can be assessed using both extremely short video test pulses and relatively long r.f. pulses. Millimicrosecond test pulses sent along the line produce echoes at impedance discontinuities; the time of travel of the pulse and thus the location of the fault can be measured relatively accurately on an oscilloscope having adequate bandwidth.

R.F. pulses also provide a means of measuring the echo voltages from obstacles and discontinuities in the aerial system. In order to discriminate between the large echo from the aerial and other possible accidental echoes in the system the shortest pulse which the system can pass should be used. Both methods are exemplified by numerous oscillograms and test results.

Z.F.Voyner

621.396.67 : 538.56

## RADIATION CHARACTERISTICS OF AN IDEALLY CONDUCTING SPHERE PLACED IN A NON-HOMOGENEOUS MEDIUM.

Yu.S.Sayasov.  
Zh. tekh. Fiz., Vol. 29, No. 12, 1486-9 (Dec., 1959). In Russian.

A generalized case of the study of the radiation characteristics of conducting bodies is considered in which the surrounding medium is non-homogeneous having a complex permittivity and working into an absorbing load.

Z.F.Voyner

621.396.674.3 : 538.56

## THE HALF-WAVE CYLINDRICAL ANTENNA IN A DISSIPATIVE MEDIUM: CURRENT AND IMPEDANCE.

5785 R.King and C.W.Harrison.  
J. Res. Nat. Bur. Stand., Vol. 64 D, No. 4, 365-80 (July-Aug., 1960).

An integral equation for the distribution of current along a cylindrical aerial in a conducting dielectric is derived. It is shown that the boundary conditions for an aerial in such a medium are formally the same as for an aerial in free space. The equation is solved for the current  $I$  and the driving-point impedance  $Z$  by means of a technique that achieves sufficiently high accuracy in the leading terms of an iteration procedure so that the higher-order terms do not need to be evaluated. Moreover, these leading terms consist only of trigonometric functions with complex coefficients. The electromagnetic field in the infinite dissipative medium may be computed relatively easily since the current in the aerial is expressed in such simple terms. A numerical analysis is made to determine the properties of an aerial with an electrical length of one-half wavelength in the medium with conductivity  $\sigma$  and relative dielectric constant  $\epsilon_r$ . Universal curves are given of  $1/\sqrt{\epsilon_r}$  with  $\sigma/\omega\epsilon_0\epsilon_r$  as the parameter and of  $Z/\sqrt{\epsilon_r}$  with  $\sigma/\omega\epsilon_0\epsilon_r$  as the variable in the range  $0 \leq \sigma/\omega\epsilon_0\epsilon_r \leq 0.4$ . A table of numerical values of the impedance is given for media such as an isotropic ionosphere, dry salt, dry earth, wet earth, and lake water.

621.396.677

## GROUND-MAPPING ANTENNAS. WITH FREQUENCY

5786 SCANNING. A.Bystrom, R.V.Hill and R.E.Metter.  
Electronics, Vol. 33, No. 19, 70-3 (May 6, 1960)

An array of vertically-polarized narrow-wall slot radiators with cross-polarization suppressing baffles and an array of horizontally-polarized leaky-grid radiators are used as models to show that the direction of the main beam can be controlled accurately by controlling the scanning frequency of the array. The experimental work was carried out in the frequency band 16 to 17 kMc/s. The scan angle was  $\pm 45^\circ$  in the azimuthal plane for both aerials. The elevation pattern coverage was  $-8^\circ$  to  $-45^\circ$  for the slot aerial and  $-16^\circ$  to  $-45^\circ$  for the leaky-grid aerial. The particular problem of data transmission associated with frequency-scanned aerials was solved by using a helical delay line with directional couplers at each end of it providing input to a phase detector.

Z.F.Voyner

621.396.677

## THE DIELECTRIC HORN AERIAL.

5787 M.Procházka.  
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 3, 93-104 (Sept., 1959). In German.

The radiation characteristics of the dielectric horn aerials are critically examined in the light of disagreements existing in the published literature about their relative gain. In particular, the effect on the mechanism of radiation of the following factors is considered: (a) aperture diameter; (b) aperture angle; and (c) the dielectric constant and the wall thickness of the dielectric material. The practical aspect of the dielectric horn is considered and it is concluded that a dielectric horn aerial with an aperture angle of  $11^\circ$  to  $12^\circ$  possesses a slightly higher gain than that obtainable with a dielectric waveguide of equal length. Similarly, the gain of a thick-walled horn aerial of medium aperture diameter and angle is some 1.5 dB higher than that of a thin-walled waveguide of equal length. 24 references.

Z.F.Voyner

- 621.396.677  
5788 INVESTIGATION OF THE REFLECTING PROPERTIES OF PLANE REFLECTORS IN THE DECIMETER-WAVE REGION. E.Düniss and K.E.Müller. Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 185-90 (Jan., 1960). In German.  
The radiation pattern, the gain and the passive losses of plane reflectors are measured experimentally and compared with the theoretical results obtained by the application of Kirchhoff's formulae to the diffraction problem. The experimental check in the decimeter-wave region gives a sufficiently satisfactory agreement with the theory to enable the results of the approximate calculations to be used as data for the design of reflectors in radio relay work.  
Z.F.Voyner
- 621.396.677 : 621.372.826  
5789 THE SURFACE-WAVE AERIAL. W.Hersch. Proc. Instn Elect. Engrs, Monogr. 363E, publ. Feb., 1960 (Vol. 107C, 202-12, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 1830 of 1960.
- 621.396.677  
5790 TRANSIENTS IN CYLINDRICAL ANTENNAE. H.J.Schmitt. Proc. Instn Elect. Engrs Monogr. 377E, publ. April, 1960 (Vol. 107C, 292-8, April, 1960).  
Republication of the Monograph already abstracted as Abstr. 3096 of 1960.
- 621.396.677  
5791 CALCULATION OF THE RADIATION PATTERN OF AN AERIAL WITH A NON-PLANE WAVE INCIDENT UPON IT. V.P.Peresada. Radiotekhnika, Vol. 15, No. 3, 18-24 (March, 1960). In Russian.  
In the measurement of radiation patterns the incident e.m. wave is considered substantially plane when the distance between the transmitting and receiving aerials satisfies the well-known relation  $R > 2a_1 a_2 / \lambda$ . Exact solution is obtained for two cases when: (a) on reception, the wavefront of the incident field is not plane, the knowledge of the pattern on transmission being a prerequisite; (b) the wavefront at the primary radiator is not plane due to various causes including interference due to reflections from the dish. For purposes of design and measurement, an approximate solution is obtained.  
Z.F.Voyner
- 621.396.677.3  
5792 DETERMINATION OF GAIN AND DIRECTIONAL CHARACTERISTIC OF A YAGI AERIAL FOR DECIMETRIC WAVELENGTHS. D.Stahl. Rdfunktech. Mitt., Vol. 4, No. 2, 85-7 (April, 1960).  
Describes the optimum arrangement of transmitting and receiving aerials for determining gain and polar diagrams. Particular mention is made of the sources of faults that may occur during these measurements. Results and the measured polar diagrams are given.
- 621.396.677.5  
5793 STUDIES OF LARGE CIRCULAR LOOP ANTENNAS. S.Adachi and Y.Mushiaki. Rep. Res. Inst. Elect. Commun. Tohoku Univ. B, Vol. 9, No. 2, 79-103 (Sept., 1957).  
Large circular loop aerials are theoretically and experimentally studied by following the fundamental formulations which were presented in a previous paper [Sci. Rep. Res. Inst. Tohoku Univ. B, Vol. 9, No. 1 (1957)]. Various characteristics such as current distribution, input impedance, radiation pattern, and power gain are calculated in the first order approximation. Some practicable experiments are performed and compared with theoretical results. Considerable agreement is found between them. The analogy between a circular loop aerial and the usual transmission line in connection with current distribution and equivalent characteristic impedance is discussed. Input impedance of a loaded loop aerial, image impedance and propagation constant of a loop aerial when considered as a four-terminal network, and load impedance for a travelling-wave type loaded-loop aerial are also calculated and discussed.
- 621.396.677.5  
5794 DIRECTIVE LOOP ANTENNAS. S.Adachi and Y.Mushiaki. Rep. Res. Inst. Elect. Commun. Tohoku Univ. B, Vol. 9, No. 2, 105-12 (Sept., 1957).  
A short-circuited circular loop aerial of about one wavelength-circumference is investigated as a new type of directive aerial. A single loop, a folded loop and a directive loop with a reflecting plane and a director are developed. These aerials have the maximum radiation of linearly polarized waves in the axial direction of the loops. Various characteristics, namely radiation pattern, gain, and input impedance are investigated experimentally and theoretically based on the fundamental studies presented in the preceding paper. As a result, directive loop aerials of these types are found to have practical applications because of their respective advantages, such as high gain, wideband characteristics and mechanical compactness.
- 621.396.677.71  
5795 AN EXPERIMENTAL STUDY OF THE SLOT AERIAL AND THE THREE-ELEMENT COLLINEAR ARRAY OF SLOT AERIALS. R.King and G.H.Owyang. Proc. Instn Elect. Engrs, Monogr. 365 E, publ. Feb., 1960 (Vol. 107C, 216-27, Sept., 1960).  
Republication of the Monograph already published as Abstr. 3108 of 1960.
- 621.396.677.833  
5796 A NEW DESIGN METHOD FOR PHASE-CORRECTED REFLECTORS AS MICROWAVE FREQUENCIES. S.Cornbleet. Proc. Instn Elect. Engrs, Monogr. 360 E, publ. Feb., 1960 (Vol. 107C, 179-89, Sept., 1960).  
Republication of the Monograph already abstracted as Abstr. 987 of 1960.
- 621.396.677.833.2 : 538.56  
5797 THE UNIQUENESS OF SOLUTION OF THE INTEGRAL EQUATIONS IN AERIAL THEORY OF THE FIRST KIND. N.N.Govorun. Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 91-4 (May 1, 1960). In Russian.  
The method of solution of the integral equation for cylindrical aerials, developed previously (Abstr. 7589 of 1959) is considered again for a perfectly conducting aerial. The equations for azimuthal and for meridional currents and fields are developed and it is shown that the method provides unique solutions.  
J.K.Skwiraynski
- 621.396.677.833.2  
5798 A BROAD-BAND SPHERICAL SATELLITE ANTENNA. H.B.Riblet. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 631-5 (April, 1960).  
The design criteria and results of the design of a broad-band spherical aerial are discussed. The parameters of design and their effect on radiation patterns are briefly investigated. The particular aerial was developed from an equiangular spiral slot plotted on a plane and then projected on the surface of a sphere. Attention is given to problems of isolation and matching when the aerial is used for multifrequency operation. The particular aerial discussed is being used in the "transit" satellite programme.
- 621.396.677.85  
5799 METAL DISC DELAY DIELECTRICS. C.Dhanalakshmi and S.K.Chatterjee. J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 2, 83-5 (Feb., 1960).  
By using a transmission-line analogy, a theory for the phase change on transmission of microwaves through an artificial dielectric composed of a three-dimensional array of metal disks is developed. The phase change is a function of the radius of the disks, the distance between the centre to centre of any two adjacent disks and the path length  $t$  traversed by the wave inside the dielectric. The phase change is an oscillatory function of  $t$ . Experimental values of the phase change as a function of  $t$  obtained by using a microwave interferometer are compared with theoretical values.

# PROPAGATION . INTERFERENCE

- 621.391.8 : 550.3 : 538.56  
5800 PROPAGATION OF ELECTROMAGNETIC PULSES IN A  
HOMOGENEOUS CONDUCTING EARTH. J.R.Wait.  
Appl. sci. Res. B, Vol. 8, No. 3, 213-53 (1960).

A general analysis for the electromagnetic response of conducting media due to pulse excitation is presented. The treatment is based on the Laplace transform theory. First, a survey of the field is made and the limitations and scope of the previous work are pointed out. The theory of propagation of a plane-wave pulse in a conducting and homogeneous medium of infinite extent is then reviewed. The form of these results enable one to evaluate the relative importance of the conductivity and the dielectric constant. It is indicated, for sufficiently large times in the transient response, that displacement currents may be safely neglected for sea water and for most geological media. On this assumption, the waveform of the electric field in a conducting medium is illustrated for the case where the source is an electric dipole energized by a step-function current. Results are also presented for exponential and bell-shaped source functions. The pulse shape of the field components is profoundly modified as they propagate through the medium. It is suggested that this property may be utilized in measuring distances in the earth's crust. The more difficult problem of propagation in non-infinite conducting media is also considered. To account for the presence of the interface in a conducting half-space (i.e. homogeneous flat ground), a rather involved analytical expression for the transient fields is required. Certain special cases, such as a horizontal electric dipole at the interface, are illustrated by numerical results. The transient excitation of a wire loop lying on the surface of a homogeneous ground is also considered. Transient coupling between pairs of parallel insulated wires grounded at their end points is treated as an extension of the earlier results.

- 621.391.8  
5801 THEORETICAL CONSIDERATIONS FOR THE ELEMENT  
ERROR RATE IN BINARY CODE TRANSMISSION.

H.Akima.  
J. Radio Res. Lab. (Tokyo), Vol. 6, 543-72 (July, 1959).

The element error rate in binary code transmission is calculated for the case of fading-free signals in the presence of random noise, using the results of Rice and Stumpers. Consideration is given to both amplitude ( $A_1$ ) and frequency-shift modulation (f.s.) and to the one-source two-band method and the discriminator method in f.s. signal reception. Tables expressing the statistical properties of a sine-wave plus random noise, the measure of detectability of the signal in the presence of noise, and the correction coefficient for the measurement of the field intensity of signal are also given.

- 621.391.812.61  
5802 ON THE MEASUREMENT OF ATTENUATION BY RAIN  
AT 8.6 mm WAVE LENGTH.

S.Okamura, K.Funakawa, H.Uda, J.Katô and T.Oguchi.  
J. Radio Res. Lab. (Tokyo), Vol. 6, 255-67 (April, 1959).

The attenuation by rain at 8.6 mm wavelength was measured by the f.m. radar method. Though the reflecting target was only 400 m distant from the aerial, attenuation could be measured under conditions of showers or typhoons which existed in September, 1958. The results may be considered to coincide roughly with Ryde's theoretical values. However, there is some difference in attenuation between vertically and horizontally polarized waves.

- 621.391.812.611.1 : 538.56  
5803 REFRACTION OF RADIO WAVES AT LOW ANGLES  
WITHIN VARIOUS AIR MASSES.

B.R.Bean, J.D.Horn and L.P.Riggs.  
J. geophys. Res., Vol. 65, No. 4, 1183-7 (April, 1960).

The refractive index structure and bending of radio rays within air masses of nonexponential refractive index height structure is treated in terms of the value expected in an average atmosphere of exponential form. It is demonstrated that refraction differences within air masses arise from departures of refractive index structure from the normal exponential decrease with height. The effect upon radio ray refraction of these departures from the normal exponential refractive index structure is most pronounced for small initial elevation angles of the radio ray.

- 621.391.812.621.1  
5804 THE "EQUIVALENT GRADIENT": DIRECT MEASURE-  
MENT AND THEORETICAL CALCULATION. P.Misme.  
Ann. Telecomm., Vol. 15, No. 3-4, 92-9 (March-April, 1960).  
In French.

Because of the variation of refractive index gradient with height, a signal propagating from one station to another of comparable altitude in the troposphere does not follow a path which is an arc of a circle. The propagation may be described in terms of propagation over a path which is an arc of a circle however using a suitable value for the "equivalent gradient" of refractive index which is now independent of height. Radar measurements of the equivalent gradient over a path from Southern France to Corsica are described and curves indicating the seasonal variation are given. Theoretical calculation of the gradient is performed and the case of trans-horizon propagation is considered. The use of the concept in this field is underlined by the fact that the value of the gradient appears to vary far less with climate and from day to day with long paths than with short paths.

G.D.Sims

- 621.391.812.623 : 538.56  
5805 DIFFRACTION BY SMOOTH CONICAL OBSTACLES.  
H.E.J.Neugebauer and M.P.Bachynski.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 4, 317-29 (July-Aug., 1960).  
Expressions obtained earlier (Abstr. 6393 of 1958; 1778 of 1959)

for the calculation of diffraction due to conducting obstacles with smooth cylindrical surfaces, are generalized to oblique incidence and to surfaces of conical shape. The derivation is based on a generalized concept of the Green's function and on the use of corrective factors that take the same place as corrections introduced by other authors into the theory of diffraction by apertures. The final expressions for conical obstacles and oblique incidence are very similar to those for cylindrical obstacles. The results are compared with scale model measurements.

- 621.391.812.624 : 538.56  
5806 THE SPECTRUM OF X-BAND RADIATION BACK-  
SCATTERED FROM THE SEA SURFACE.

B.L.Hicks, N.Knable, J.J.Kovaly, G.S.Newell, J.P.Ruina and  
C.W.Sherwin.  
J. geophys. Res., Vol. 65, No. 3, 825-37 (March, 1960).

A coherent radar was used to measure the "sea clutter" or backscattering of X-band electromagnetic energy from the sea surface. More than 200 recorded samples of clutter were analysed to give power spectra of the clutter. Each spectrum was displayed as a function of frequency and of position on the water surface and was also averaged to give the mean spectrum of patches 3750 feet long. Five of the samples showed an anomalous downwind displacement of the clutter by as much as 7 knots. The displays indicate again, as in earlier measurements, that the upwind edge of the clutter spectrum is smooth for all wind speeds observed, but that the downwind edge, for sea state 3 or above, is broadened in an irregular fashion as a function of range. This irregular broadening implies a considerable variability, from patch to patch, in the downwind side of the probability distribution of velocity of scatterers on the sea surface. The width at half-power of a mean spectrum is proportional, for reasonable assumptions, to the width at half-maximum of the probability distribution of scatterer velocities. The variation of the latter width,  $\Delta_0$ , with sea state can be represented by the equation (expressed in consistent units)  $\Delta_0 = 11H_{1/3}/T_m$ , where the numerical factor is dimensionless,  $H_{1/3}$  is the significant wave height, and  $T_m$  is the period corresponding to the maximum of the energy spectrum for the water waves themselves when this spectrum is plotted as a function of frequency. This equation fits the experimental data within about 10% for bandwidths in the range of 2 to 5 knots (64 to 160 c/s) and wind speeds in the range of 8 to 19 knots. The bandwidth of the clutter is found to be approximately proportional to the wind speed. The relationships of clutter bandwidths to wave and whitecap velocities, radar depression angle, and wind direction are also discussed.

- 621.391.812.624 : 538.56  
5807 ON THE QUESTION OF MULTIPLE SCATTERING IN  
THE TROPOSPHERE. D.S.Bugnolo.

J. geophys. Res., Vol. 65, No. 3, 879-84 (March, 1960).

A criterion is developed to serve as a measure of multiple scattering in the troposphere as a result of dielectric noise. The question to be answered is: what is the probability that any ray of the incident field will be scattered at least twice in a distance R? This useful criterion can serve as a measure of reliability for the



usual single-scatter approximations. It is developed in detail for an arbitrary dielectric noise and is applied to a number of special cases. The results indicate that multiple-scattering effects should be of importance in the microwave spectrum.

621.391.812.624 : 538.56

# 5808 RADIO PROPAGATION PREDICTION CONSIDERING SCATTERING WAVES ON THE EARTH'S SURFACE.

K.Miya and S.Kanaya.

Rep. Ionosphere Res. Japan, Vol. 9, No. 1, 1-15 (March, 1955).

The control-point method is usually employed in the prediction of the behaviour of radio-wave propagation in long-distance radio communication channels. For a particular channel, however, this method often gives results disagreeing with observation. With the intention of improving the percentage of successful prediction, this paper deals with the investigation of the method of applying scattering waves on the earth's surface to the prediction of radio-wave propagation conditions. A new method called "the control-line method" is proposed. The method of the Ionospheric Prediction Service of Australia, which aims at correcting errors in prediction of propagation conditions, is discussed.

621.391.812.63 : 538.56

# 5809 ON THE PROPAGATION OF E.L.F. RADIO WAVES AND THE INFLUENCE OF A NONHOMOGENEOUS IONOSPHERE. J.R.Wait.

J. geophys. Res., Vol. 65, No. 2, 597-600 (Feb., 1960).

The model assumed consists of a spherical earth surrounded by a concentric ionosphere whose electron density increases exponentially with height. This elaboration of the usual homogeneous model appears to explain the observed attenuation for terrestrial propagation as a function of frequency in the range 100 c/s to 1 kc/s.

621.391.812.63

# 5810 NIGHT-TIME EQUATORIAL PROPAGATION AT 50 Mc/s: FIRST RESULTS FROM AN I.G.Y. AMATEUR OBSERVING PROGRAM. M.P.Southworth.

J. geophys. Res., Vol. 65, No. 2, 601-7 (Feb., 1960).

During I.G.Y. the American Radio Relay League collected radio amateur reports of 50- and 144-Mc/s ionospheric propagation, evaluated them, and transcribed them onto punched cards. Analysis of 50 Mc/s equatorial intercepts, begun this summer at Stanford University, has revealed three apparently related types of nocturnal low-latitude propagation: (1) long-range transequatorial, as first noticed by amateurs in 1947; (2) medium-range, between stations making transequatorial contacts and stations near the magnetic equator; (3) short-range, similar to sporadic E but occurring regularly with the first two types. Where ever they appear these modes are present almost nightly during certain months, and evening propagation of frequencies up to 1.5 times the maximum daylight m.u.f. is not uncommon. Comparison of transequatorial results in the Americas and the Far East has shown that seasonal behaviour is not the same at all meridians. Pronounced negative correlation with magnetic activity is a world-wide feature, however, which suggests a direct relation to equatorial spread F. Quantitative professional data at the frequencies of interest are rather rare, but comparisons with backscatter soundings made at the University of Puerto Rico indicate that the 20 and 40 Mc/s transequatorial propagation seen there is not the same as what amateurs experience on 50 to 75 Mc/s.

621.391.812.63 : 523.75

# 5811 SHORT-WAVE FADEOUTS WITHOUT REPORTED FLARES. H.DeMastus and M.Wood.

J. geophys. Res., Vol. 65, No. 2, 609-11 (Feb., 1960).

Short-wave fadeouts were sought which had no associated H $\alpha$  flare. To carry out this study, Sacramento Peak flare patrol films were re-examined for those days on which short-wave fadeouts (s.w.f.s.) had occurred during patrol times without reported flares. Fifteen such fadeouts were reported during the I.G.Y. period. Upon re-examination of the films, 12 of the s.w.f.s. were found to be in close time association with outstanding H $\alpha$  events, usually in the nature of pronounced plage brightenings. In 2 other cases, seeing was so poor that no definite statement could be made about possible H $\alpha$  activity. In only 1 case was there definitely no unusual H $\alpha$  event in time association with the fadeout. For each of the 15 cases, the flare film for the entire day was re-examined without previous knowledge of the time of the s.w.f. Any periods of outstanding H $\alpha$  activity were selected and their times noted; only after their independent selection were their times matched to s.w.f. times. Usually

there was only 1 such outstanding period of optical activity per day. The time association with s.w.f. was, in general, very close. The results indicate that outstanding H $\alpha$  activity is essential in time relation with s.w.f. occurrence.

621.391.812.63

# 5812 POLARIZATION PARAMETERS OF THE DOWN-COMING RADIO WAVE. Y.S.N.Murty and S.R.Khastgir.

J. geophys. Res., Vol. 65, No. 5, 1449-57 (May, 1960).

The phase difference between the normal and abnormal components of the magnetic vector of the radio wave (i.e., the components in and at right angles to the plane containing the wave normal and the direction of the earth's magnetic field) and the limits of the tilt angle of the major axis of the polarization ellipse (traced out by the electric vector) measured anticlockwise with respect to the direction of magnetic north for the ordinary and extraordinary modes of propagation were obtained from the ray theory of propagation through the ionosphere. The values are given in a table for the ordinary and extraordinary modes in both hemispheres for regions below and above the level of ionospheric reflection. Scott's treatment of the same problem on ray theory and the results given by Roy and Verma on the basis of the coupled wave equations of Saha and others are reviewed. It is shown that discrepancies in the results of the polarization parameters obtained by different workers on ray theory are only apparent and arise out of differences in the forms and notations used in the different formulae. It is also shown that discrepancies in the limits of the major axis of the polarization ellipse obtained from ray theory and wave theory are due to the interchange in the expressions for the amplitude ratio of the normal to the abnormal components for the ordinary and extraordinary waves given by Saha and others. The experimental results of Roy and Verma are shown to confirm theoretical conclusions about the limits of the tilt angle of the polarization ellipse.

538.56 : 621.391.812.63

# 5813 THE CALCULATION OF THE M.U.F. FACTOR FOR A NON-PARABOLIC IONOSPHERIC LAYER. M.D.Vickers.

J. atmos. terrest. Phys., Vol. 17, No. 1-2, 34-45 (1959).

A method is described for calculating the ray path of a radio wave through the ionosphere as represented by an N(h) profile based on experimental data. A few such paths are calculated and from these are obtained maximum usable frequency factors. These factors are compared with those which would have been obtained had the existing methods of calculation been used. In most cases the differences are less than 4%.

621.391.812.63 : 551.5 : 525

# 5814 FARADAY EFFECT IN THE TRANSMISSIONS FROM FAST SPINNING SATELLITES.

R.S.Roger and J.H.Thomson.

Nature (London), Vol. 186, 622-3 (May 21, 1960).

The interaction of satellite spin and the Faraday rotation effect in the ionosphere in producing polarization fading in linearly polarized signals is discussed for the case when the rotation period is small compared to the Faraday fading period. Records of certain satellite transmissions taken at Jodrell Bank experimental station are at present being analysed to determine ionospheric electron contents.

A.Boksenberg

621.391.812.63

# 5815 UNUSUAL PROPAGATION OF SATELLITE SIGNALS. E.M.Dewan.

Proc. Inst. Radio Engrs., Vol. 47, No. 11, 2020 (Nov., 1959).

On consecutive days (October 18-21, 1958) the signals of Sputnik 1 were recorded at Bedford, Mass. The recorded amplitudes showed peaks at satellite ranges of 2000 and 730 miles, which were comparable with the overhead signal level. A magnetic tape recording showed that up to three closely spaced frequencies were received during the peak periods, and the end of the period two of the frequencies approached the same value. At the relevant times Sputnik 1 was just below the maximum of the F-layer, and the earth reflections were from the ocean.

W.T.Blackburn

621.391.812.63 : 525 : 551.5

# 5816 IONOSPHERIC SCINTILLATIONS OF SATELLITE SIGNALS. H.P.Hutchinson and P.R.Arendt.

Proc. Inst. Radio Engrs., Vol. 48, No. 4, 670-1 (April, 1960).

The scintillation of satellite-emitted radio signals has been observed using two different techniques, namely Doppler-shift frequency measurements and radio direction-finding. The results obtained using Doppler-shift measurements are given. Variations

from a smooth Doppler-shift curve obtained during individual orbits give a measure of the frequency scintillation occurring and thus of the roughness of the ionospheric path between the satellite and the observer. As expected, these variations are a function of frequency, and they become less as the frequency is increased. Further details of the investigation are to be published later.

621.391.812.63 : 525

## THE SATELLITE IONIZATION PHENOMENON.

5817 J.D.Kraus, R.C.Higgy and W.R.Crone.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 672-8 (April, 1960).

A number of observations are presented which show a close correlation between c.w.-reflected h.f. signals and passes of artificial earth satellites. The periodic (nonrandom) occurrence of the signal bursts and the symmetry of some burst sequences are indicative of satellite-related phenomena. The occurrence of a variety of satellite-related Doppler effects is described and several satellite ionization mechanisms are also discussed. The possible relation of the satellite phenomenon to prior solar activity is mentioned.

621.391.812.8 : 523.74 : 551.5

WORLD MAPS OF  $F_2$  CRITICAL FREQUENCIES AND MAXIMUM USABLE FREQUENCY FACTORS FOR USE IN MAKING IONOSPHERIC RADIO PREDICTIONS.

D.H.Zacharisen and V.Agy.

J. geophys. Res., Vol. 65, No. 2, 593-5 (Feb., 1960).

A recent publication of the National Bureau of Standards is described which gives charts for use in predicting the classical  $F_2$ -layer maximum usable frequency for any sunspot number. The charts present  $f_oF_2$  and the M3000 factor at sunspot number 50, and the rates of change of these parameters with sunspot number. A short history of N.B.S. activity in this field is presented, together with a comprehensive list of publications giving methods and tools used in making predictions by various organizations throughout the world.

621.391.814

ON THE GRAPHICAL METHOD OF CALCULATION OF THE FIELD STRENGTH FOR EFFECTIVE EARTH RADIUS OTHER THAN  $4/3$  TIMES THE ACTUAL RADIUS AND FOR ANY ANTENNA HEIGHTS AND FREQUENCIES. K.Tao and K.Sawaji.

J. Radio Res. Lab. (Tokyo), Vol. 6, 311-72 (April, 1959).

621.391.821 : 551.5

## A FOUR-YEAR SUMMARY OF WHISTLER ACTIVITY AT WASHINGTON, D.C. H.E.Dinger.

J. geophys. Res., Vol. 65, No. 2, 571-5 (Feb., 1960).

Whistler and dawn chorus activity as recorded at Washington, D.C., during the period of July 1, 1955, to June 30, 1959, is tabulated and summarized. Of the 1461 days considered in this analysis, 94% had activity of some form. The equivalent of approximately five hundred 1800 ft reels of magnetic recording tape was analysed. The last 2 years of the period covered was part of the I.G.Y./I.G.C. Ionospheric Physics Programme.

621.391.821

## EXTRA-TERRESTRIAL RADIO NOISE AS A SOURCE OF INTERFERENCE IN THE FREQUENCY RANGE

30-1000 Mc/s. F.Horner.

Proc. Inst. Elect. Engrs, Paper 3267 E, publ. July, 1960 (Vol. 107 B, 373-6).

Published information on the intensity of noise from the galaxy, the sun and from other extra-terrestrial sources is presented in a form which shows their importance relative to the internal noise of typical receiving installations. Particular attention is paid to a half-wave horizontal dipole aerial and to an aerial with a  $20^\circ$  pencil-beam directed horizontally.

621.391.822

## STATISTICAL PROPERTIES OF MEASURED NOISE POWER. A.P.Bolle.

P.T.T. Bedrijf, Vol. 9, No. 3, 145-55 (Nov., 1959).

A noise current  $i_n$  is applied to a square-law detector. The output current  $i_o$  of this detector equals  $i_n^2$  and is applied to a linear quadrupole with a gain-frequency characteristic  $A(f)$ . The output current  $i_o$  of this quadrupole is called the measured noise power  $w$ . A general expression for the ratio of the standard deviation  $\sigma_w$  and the mean value  $\bar{w}$  of this random variable  $w$  is derived. For special

cases of energy spectra of  $i_n$  and of  $A(f)$ , curves are drawn relating  $\sigma_w/\bar{w}$  and the measuring time-constant, represented by the gain-frequency characteristic  $A(f)$ . For some assumed probability density functions of  $w$  the exceeding probabilities are calculated as a function of  $\sigma_w/\bar{w}$ .

621.391.826.2

## EFFECTS OF OBSTACLES AND REFLECTIONS ON THE PROPAGATION OF V.H.F. TELEVISION SIGNALS.

B.Chatterjee.

J. Inst. Telecomm. Engrs, Vol. 6, No. 1, 47-50 (Dec., 1959).

Studies were carried out on the v.h.f. propagation of television signals with special reference to the effects of reflection from nearby objects. In addition to the normal phenomenon of ghost images, another peculiar effect of reflection was noted. Attempts are made to explain the effect on the basis of interaction between direct and reflected signals.

621.391.837

## THE VISUAL INTERFERENCE EFFECT OF HORIZONTAL PICTURE INSTABILITY IN TELEVISION.

V.Messerschmid.

Rdfunktech. Mitt., Vol. 4, No. 2, 74-9 (April, 1960).

When transmitting video-tape recordings and also live transmissions using a wave-form generator synchronized with the supply mains, there can occur horizontal oscillatory movement of the picture that may considerably impair the subjective impression of the picture. Experiments were carried out with still and moving-pictures with sinusoidal fluctuations throughout the entire frequency range in question from 0.5 to 20 c/s. It is shown that the subjective visual effect was most acute at frequencies between 5 and 15 c/s. For example, with still pictures, a picture displacement of amplitude 0.3 picture elements is "just visible", one picture element corresponding approximately to 0.15% of the line period. In addition to displacement of the picture as a whole, relative movement of individual picture areas was also examined. The range of maximum sensitivity was very considerably increased. It is shown that the upper limit for the maximum permissible amplitude of horizontal picture displacement lies around 0.7 picture elements.

## RADIO APPLICATIONS . RADAR

621.396.931.2

## NAVIGATION USING SIGNALS FROM HIGH-ALTITUDE SATELLITES. A.B.Moody.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 500-6 (April, 1960).

Satellites in orbits a few hundred miles from the earth might be used in some form of piloting system, but orbit-prediction problems, limited coverage by individual satellites, and computer complexities are serious obstacles to be overcome by such a system. A different approach would be to place three or four satellites in orbits at an optimum distance somewhere between 1000 and 12000 miles from the earth to serve as artificial celestial bodies in a system that would be a natural evolution from traditional celestial navigation methods. A stabilized directional aerial operating with a receiver capable of accepting signals from both the satellites and the sun would provide angle measurement data both for fixing the position of the craft and also for establishing a north reference. The degree of sophistication of the user equipment would differ with requirements.

621.396.931.2 : 538.56

## A STUDY OF NATURAL ELECTROMAGNETIC PHENOMENA FOR SPACE NAVIGATION.

R.G.Franklin and D.L.Birx.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 532-41 (April, 1960).

A study was made of the use of natural electromagnetic radiation in the space environment for navigation purposes. Radiations from the sun, stars, and interstellar space in both the visible and r.f. portions of the spectrum and also cosmic rays were investigated. Emphasis is placed on the measurement of velocity in space utilising the Doppler phenomenon. Equipment and techniques useful in deriving velocity information from Doppler shift measurements are described and figures for expected accuracy are derived. Other passive techniques having possible application to space navigation such as the measurement of total solar radiation and solar diameter are briefly discussed.

- 621.396.931.2  
**5827 A SATELLITE DOPPLER NAVIGATION SYSTEM.**  
 W.H.Guler and G.C.Weiffenbach.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 507-16 (April, 1960).  
 It is shown that a satellite Doppler navigation system can provide navigation to at least one-half mile accuracy from a single pass of a satellite, provided that proper use is made of the full Doppler curve. While not extensively discussed, a satellite Doppler navigation system is presented which conveniently provides navigators with all necessary inputs for position calculation, including up-to-date orbital data. The main body of the paper presents the results of a comprehensive error analysis which proves the feasibility of achieving navigational accuracies of one-half mile using such a system under realistic conditions.
- 621.396.933  
**5828 DIRECT VISION TYPE DIRECTION FINDER FOR HIGH FREQUENCY.**  
 K.Miya, T.Sasaki, M.Ishikawa and S.Matsushita.  
 Rep. Ionosphere Res. Japan, Vol. 11, No. 1, 1-10 (March, 1957).  
 Describes a direct-vision type direction finder with which either multiple or scattering signals can be measured. The principle of the finder is the so-called differential output method which is realized by using an electrical time-division system. The frequency range is 3-23 Mc/s and the minimum measurable field intensity is estimated at -27 to -40 dB above 1  $\mu$ V/m. The bearing of an incoming wave is indicated by a sharp unidirectional figure on a c.r.t.
- 621.396.946 : 525  
**5829 MEASUREMENTS OF THE LAST FEW PERIODS OF SPUTNIK III BY A RADIO DIRECTION FINDER.**  
 J.L.Wolfe.  
 Canad. J. Phys., Vol. 38, No. 6, 882 (June, 1960).  
 The calculated times of crossing the 45th parallel along with the times of nearest approach to Ottawa (45° 21' N, 75° 34' W), and also the calculated mean periods, are tabulated for the last 2 weeks of life.  
 A.Boksenberg
- 621.396.946  
**5830 PICTORIAL DATA TRANSMISSION FROM A SPACE VEHICLE.** J.F.Baumunk and S.H.Roth.  
 Elect. Engng, Vol. 79, No. 2, 134-8 (Feb., 1960).  
 The problems of radio communication are discussed in general terms. System parameters are deduced for a television link between the moon and earth capable of transmitting a 500-line frame in 1 minute, with a 20 dB signal-noise ratio. The working frequency chosen is 1000 Mc/s with f.m./f.m. modulation. Given a 60 ft dish aerial feeding a 2 dB noise-factor receiver, a transmitter power of 300 W would be required.  
 W.T.Blackband
- 621.396.946  
**5831 OPTIMUM FREQUENCIES FOR OUTER SPACE COMMUNICATION.** G.W.Haydon.  
 J. Res. Nat. Bur. Stand., Vol. 64D, No. 2, 105-9 (March-April, 1960).  
 Frequency dependence of radio propagation and other technical factors which influence outer space communications are examined to provide a basis for the selection of frequencies for communication between earth and a space vehicle or for communication between space vehicles.
- 621.396.946 : 525 : 551.5  
**5832 THE N.A.S.A. SPACE SCIENCES PROGRAM.**  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 438-50 (April, 1960).  
 This report, prepared in April, 1959, summarizes the objectives of the space sciences programme of the U.S. National Aeronautics and Space Administration and the immediate and long-range plans for carrying out the programme. The report is divided into several broad areas; atmospheres, ionospheres, energetic particles, electric and magnetic fields, gravitational fields, astronomy, and biosciences. A review of present knowledge and existing problems in each of the above areas is included.
- 621.396.946  
**A PRAGMATIC APPROACH TO SPACE COMMUNICATION.** G.E.Mueller.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 557-66 (April, 1960).  
 Examination of the fundamental limitations on modulation efficiency and present practices in transmitter design, solar cell power sources, receiver design and aerial design shows that communication with large information rates is possible throughout the solar system but that practical interstellar communication is not now feasible. Two representative telemetry systems are discussed, the f.m./p.m. analogue Microlock system and the digital Telebit system.
- 621.396.946  
**5834 PROPAGATION AND COMMUNICATIONS PROBLEMS IN SPACE.** J.H.Vogelman.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 567-9 (April, 1960).  
 The problems of propagation and communications arising from landings on the Moon, Venus, or Mars are treated in terms of the characteristics required for the communication system to achieve data transfer between parties on the surface of these bodies and the communications problems arising in the transfer of information from these bodies back to the Earth. Consideration is given to Doppler shift, Faraday rotation, tracking and stabilization of aeri-als, and ground network requirements. The problems of communications between vehicles in space in terms of signal acquisition and aerial orientation and tracking are described.
- 621.396.946  
**5835 PROPAGATION-DOPPLER EFFECTS IN SPACE COMMUNICATIONS.** F.J.Tischer.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 570-4 (April, 1960).  
 A generalized form of the Doppler equation is derived by field theory. The equation permits consideration of the effect of propagation phenomena on the Doppler shift under space flight conditions. As an example of an application, the effect of a medium which is nonhomogeneous in the flight direction is investigated. A deviation of the longitudinal and a transverse Doppler shift are the consequences. The magnitudes of both effects, which have to be taken into account in tracking, navigation, and Doppler evaluations, are considered.
- 621.396.946  
**5836 COMMUNICATION EFFICIENCY COMPARISON OF SEVERAL COMMUNICATION SYSTEMS.** R.W.Sanders.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 575-88 (April, 1960).  
 Of increasing importance in communication systems, particularly those required for data transmission from space craft, is the minimization of the total transmitted energy required to transmit a given amount of data. Modulation systems can be compared on the basis of a figure of merit defined as the ratio of energy required per bit transmitted in the presence of a given noise spectral density. Using this criterion, several families of communication systems are compared, including a.m., f.m., f.m./f.m., and orthogonal matched filter communication systems. It is found that the orthogonal systems uniformly require less power to transmit at a given information rate than other systems and approach closely the theoretical limit established by Shannon's channel capacity theorem.
- 621.396.946  
**5837 MAXIMUM UTILIZATION OF NARROW-BAND DATA LINKS FOR INTERPLANETARY COMMUNICATIONS.**  
 W.F.Sampson.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 589-93 (April, 1960).
- 621.396.946 : 523.16  
**5838 EXTRATERRESTRIAL NOISE AS A FACTOR IN SPACE COMMUNICATIONS.** A.G.Smith.  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 593-9 (April, 1960).  
 The various cosmic and solar system radio sources are considered with respect to their intensities, spectral distributions, and temporal characteristics. The most severe forms of interference occur in the long-wave length regions of the radio-frequency spectrum, so that the future of space communications probably lies in the perfecting of low-noise microwave systems.
- 621.396.946  
**PROJECT SCORE.**  
**5839 S.P.Brown and G.F.Senn.**  
 Proc. Inst. Radio Engrs, Vol. 48, No. 4, 624-30 (April, 1960).  
 Provides a review and summary of development, construction and operation of the first satellite communication system placed in orbit on 18 Dec., 1958. Project Score (Signal Communication by Orbiting Relay Experiment) utilized a delayed-repeater type satellite-package contained in an Atlas missile. This described an elliptical orbit approximately 600 by 100 miles and remained operational for twelve days until stopped by battery failure. Two complete systems



using slightly different frequencies were provided and the parameters and component characteristics for these are tabulated e.g., receiver weight 0.75 lb., volume 39 cu.ins. power drain 0.24 W. Also contained was a completely transistorized recorder-reproducer on which speech and other signals were recorded and afterwards retransmitted to ground. Special precautions were taken in mounting the components both for vibration and thermal effects. Overall, they withstood a "g" of 10 from 20 to 2000 c/s and 0.25 in. excursion from 5 to 20 c/s. The actual temperature was 20° F higher than expected at 140° F. Some fortuitous recordings were received from unidentified stations showing that a simple tone keyed command system was highly inadequate for future satellite control. Photos and block schematics of both satellite and ground stations are given.

B.B.Austin

621.396.946

#### 5840 EXTRA-TERRESTRIAL RADIO TRACKING AND COMMUNICATION.

M.H.Brockman, H.R.Buchanan, R.L.Choate and L.R.Malling. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 643-54 (April, 1960).

The design principles of the TRAC(E) (Tracking and Communication, Extra-terrestrial) system are presented in conjunction with a description of the equipment and actual performance data taken during the Pioneer IV lunar mission in March, 1959. The TRAC(E) system is an integral part of the N.A.S.A./J.P.L. radio tracking station located near Goldstone Lake north of Barstow, Calif. Future plans for improving the performance of the TRAC(E) system are indicated.

621.396.96

#### 5841 ARE RADAR RADIATIONS DANGEROUS? A SURVEY OF THE POSSIBLE HAZARDS. C.B.Bovill.

Brit. Commun. and Electronics, Vol. 7, No. 5, 363-5 (May, 1960).

With the building of a new high-powered early-warning radar system in the North of England the possible dangers from irradiation are reconsidered. From simple calculations it is shown that damage to living organisms are likely to occur up to about two miles from the transmitter in the direction of the beam. For conventional systems this distance is considerably less.

C.A.Hogarth

621.396.96

#### 5842 A CORRECTION NECESSARY FOR THE APPLICATION OF THE DOPPLER EFFECT TO THE MEASUREMENT OF DISTANCES TO SATELLITES. J.M.Brito.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 2023 (Nov., 1959).

The simple equation derived for the satellite range is based upon the assumption of a flat earth. An expression is derived which allows for earth curvature. For a satellite at a height of 1500km, the minimum range calculated by the new equation is 19% less than that deduced from the simple formula.

W.T.Blackband

621.396.96 : 525

#### 5843 MEASUREMENT OF THE DOPPLER SHIFT OF RADIO TRANSMISSIONS FROM SATELLITES. G.C.Weiffenbach.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 750-4 (April, 1960).

Describes a receiving station network that was designed to produce Doppler data for use in a satellite Doppler navigation system. As a result of practical exigencies, this equipment is not optimum for its intended purpose, and a continuous effort is being maintained to improve the system. Current and projected changes are described briefly. Some experimental results obtained with the present system are presented.

621.396.96 : 525

#### 5844 APPLICATIONS OF DOPPLER MEASUREMENTS TO PROBLEMS IN RELATIVITY, SPACE PROBE TRACKING, AND GEODESY. R.R.Newton.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 754-7 (April, 1960).

A discussion is given of the precision with which the Doppler shift in the signal received from a space vehicle can be measured, using existing atomic frequency standards on the ground, and a proposed transponder system on the vehicle. Applications of Doppler methods to measuring the gravitational redshift, to tracking space probes and measuring certain astronomical constants, and to geodesy, making use of the precision of atomic standards, are then presented. The conclusion drawn is that Doppler methods can improve upon existing accuracy in these areas.

621.396.96 : 525 : 530.12

#### 5845 A DOPPLER-CANCELLATION TECHNIQUE FOR DETERMINING THE ALTITUDE DEPENDENCE OF GRAVITATIONAL RED SHIFT IN AN EARTH SATELLITE.

R.S.Badessa, R.L.Kent, J.C.Nowell and C.L.Searle. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 758-64 (April, 1960).

A cancellation technique permits measurement of the frequency of a source moving relative to an observer without the obscuring effect of first-order Doppler shifts. The application of this method to a gravitational red-shift experiment involving the use of an earth satellite containing a highly stable oscillator is described. The rapidity with which a measurement can be made permits the taking of data at various altitudes in a given elliptical orbit. Tropospheric and ionospheric effects upon the accuracy of results are estimated.

621.396.962.25

#### 5846 ANALYSIS OF A FREQUENCY-MODULATED CONTINUOUS-WAVE RANGING SYSTEM.

A.J.Hymans and J.Lait.

Proc. Instn Elect. Engrs, Paper 3264 E, publ. July 1960 (Vol. 107 B, 365-72).

Some aspects of an f.m. c.w. radar with a sawtooth frequency sweep are considered. The exact beat note for a discrete target is calculated and its Fourier transform is obtained. A scheme previously given by Gnanalingam for producing a coherent system is shown to be only approximately valid, and an alternative method is proposed. The effect of Doppler shift on the return is discussed. Range discrimination is examined critically.

621.396.963.325 : 525

#### TRACKING AND DISPLAY OF EARTH SATELLITES.

5847 F.F.Slack and A.A.Sandberg.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 655-63 (April, 1960).

In a new method of displaying the predicted paths and real-time positions of artificial earth satellites, cathode-ray tubes are used with two types of map overlay: orthographic projection and Mercator projection. Functions to match these projections are generated electronically. Auxiliary satellite information is catalogued and made available through "light gun" interrogation of the satellites displayed on the c.r.t. The display and orbit simulator can be used as an integral part of a live tracking system. A mathematical derivation of the subsatellite path on the orthographic projection is given.

621.396.967.2

#### WEATHER RADAR ORGANIZATION AND SOME OBSERVATIONS IN INDIA. L.S.Mathur.

J. Inst. Telecomm. Engrs (New Delhi), Vol. 6, No. 1, 12-22 (Dec., 1959).

Describes in detail the organization of weather radar stations established by the India Meteorological Department in India, including plans for the immediate future network of storm-detecting radar stations in the country. A brief summary of the specifications of different types of weather radar echoes obtained from thunderstorm, monsoon rain, duststorm, etc., are also given. Examples selected give a broad classification of different types of echo obtained in the tropics and act as the starting point for a more detailed classification of weather radar echo patterns observable in this part of the world.

621.396.967.2

#### THE ELBE-WESER SHORE-BASED RADAR SYSTEM.

5849 C.le Comte, O.Hilke, J.M.G.Seppen and W.J.Verhoeff.

Tijdschr. Ned. Radiogenoot., Vol. 25, No. 2, 59-103 (1960).

In the estuaries of the rivers Elbe and Weser a chain of radar stations is being erected, of which some are accommodated in buildings on the river banks and others in lighthouses amidst mudflats. These stations form a system protecting shipping in the waterways. Equipment of advanced design, in which tubes are largely replaced by transistors, is used. After an outline of the preparatory work a description is given of the system, with a few particulars of the techniques used in the equipment.

621.396.969.35

#### 5850 DETERMINATION OF CORRECTIONS TO MARK II MINITRACK STATION COORDINATES FROM ARTIFICIAL SATELLITE OBSERVATIONS. W.D.Kahn.

J. geophys. Res., Vol. 65, No. 3, 845-9 (March, 1960).

The Mark II Minitrack (radio interferometer system) receives

satellite signals at a frequency of 108 Mc/s. Observations give the times corresponding to zero and  $180^\circ$  difference in phase of the satellite signal as it is received at two separate aeriols. The predicted positions of the satellite for these times are compared with the deduced positions of the satellite for the same times. From these comparisons, corrections to the observer's latitude and longitude (but not height above the reference ellipsoid) are obtained.

621.396.969.35

# 5851 THE OPTIMIZATION OF ASTRONAUTICAL VEHICLE DETECTION SYSTEMS THROUGH THE APPLICATION OF SEARCH THEORY. N.S.Potter.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 541-53 (April, 1960).

A generalized theory of detection system performance is developed and applied to the analysis of collision warning and the optimal allocation of search effort for astronomical vehicles. The kinematic basis of the relative frequency of intercepts with randomly moving particles is presented. The pronounced variation in warning system effectiveness if the possible contact space is uniformly scanned is displayed by investigating the functional behaviour of the weighted mean acquisition range and cumulative probability of detection by some minimal detection barrier in the hypervelocity closure rate, low signal amplitude operational environment. Fixing the search system frame-time, it is shown that the probability of acquiring a closing particle by some critical range determined by the system response delay may be made independent of the bearing angle of the relative approach path by choosing search system dwell-times that are proportional to the second or fourth power of the mean anticipated closure rate, the exponent being dependent upon whether the sensor is active or passive. The rational choice of the frame time is investigated in terms of the information rate out of the sensor and the requirements of the decision-making apparatus. The latter is assumed to be an unsaturated, bandwidth and memory limited data-processing subsystem. The probability of track retention and the variance of the best estimate of the contact-bearing angle are related to the cumulative probability of detection. It is shown that the required system reaction times are in conflict with the optimal detection system information rates. The very important case of contacts between astronauts and other objects independently moving on trajectories defined by a generalized central force field is separately considered. It is shown that while a true collision contact is only possible in trivial cases, as viewed by the astronomical vehicle the relative terminal approach trajectory of the particle is essentially confined to a surface defined by reasonable navigational system outputs. The confinement of the search to this restricted region of contacts makes the problem of detection in such an unfavourable environment far more amenable to solution than is possible with omnidirectional coverage.

621.396.969.35

# 5852 THE NAVY SPACE SURVEILLANCE SYSTEM. R.L.Easton and J.J.Fleming.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 663-9 (April, 1960).

A complete system for satellite detection and tracking and for computations of satellite orbits is described. This detection system uses a c.w. transmitter separated from two receiving sites, all having fan-type co-planar aerial beams. The angle of arrival of the reflected signals is measured at each station by the use of an interferometer. The position of the reflecting object is inferred by the point in the fan aerial beam defined by the intersection of the arrival angles at the two receiving stations. Two radar (radio detection and location) devices of the type described have been installed in the southern U.S. In addition to the detecting and tracking installation the system includes data transmission lines, a data reduction centre, a very high speed computer for orbit determination and predictions, and display devices.

## TELEVISION

621.397.13

# 5853 DELAY AND TRANSIENT PROBLEMS IN TELEVISION BROADCASTING. S.F.Brownless.

Proc. Instn Radio Engrs Australia, Vol. 21, No. 4, 253-64 (April, 1960).

A survey of transient distortions in a television broadcasting system. It is shown that in monochrome video circuits, their main

source lies in imperfections in the amplitude-frequency and delay-frequency responses. The vestigial sideband radio systems employed introduce additional non-linearity and amplitude-dependent phase errors. Definitions of some of the observed effects of transient distortion, such as ringing, streaking, smearing, overshoot, preshoot, and tilt are given. Based on subjective estimates of the tolerable limits of these, a system of maximum values of waveform distortion is developed, used by the Australian Broadcasting Board for checks on television transmission equipment and radiated signals. The checking of radiated signals requires a monitor receiver of standard characteristics. Commercial receivers will tend to approximate these characteristics, which have been established in consultation with the industry. Methods of transient response measurement are described, and the relation between transient and steady-state response outlined. Different ways of specifying delay, and methods of measuring them, are surveyed. This leads to a description of amplitude, delay and waveform correctors, and a discussion of present trends in development and some future prospects.

621.397.13

# 5854 A NARROW BAND IMAGE TRANSMISSION SYSTEM WITH TRANSISTORIZED RECEIVER. J.S.Riordon.

Trans Engrg Inst. Canada, Vol. 3, No. 4, 113-18 (Dec., 1959).

The relationship between bandwidth, frame rate, and resolution in an image transmission system is derived. An experimental all-electronic slow scan system is described. A frame with a resolution of approximately 100 by 100 elements is transmitted in 3.5 sec with a bandwidth of 2 kc/s. The transmitted signal is proportional to reflected, rather than transmitted, light, so that it is not necessary to make photographic slides of the material to be scanned. Considerable saving in size and power consumption is effected by the use of audio transistors in the receiver.

621.397.132

# 5855 VESTIGIAL SIDEBAND EQUALIZATION OF THE COLOUR SIGNAL IN THE N.T.S.C. SYSTEM. H.Schöndfelder.

Arch. elekt. Übertragung, Vol. 14, No. 1, 37-46 (Jan., 1960). In German.

After a brief discussion of vestigial sideband transmission, distortion and equalization, the double modulation of the chrominance sub-carrier in the N.T.S.C. system is analysed. It is shown that because of the single sideband transmission of the I-signal, the high-frequency spectrum of this signal is attenuated, and a cross-modulation of the Q-channel takes place. In a colour receiver using a Q-I decoder, simple equalization by means of filters is possible; a staircase equalizer will lift the upper frequency response, decrease the rise time for a step function from 0.6 to 0.25  $\mu$ sec and thus improve colour resolution. The phase response is affected, however, being noticeable as low frequency overshoots. A plea is made to perform the I-signal equalization in the colour modulator of the transmitter, where obviously much more complex filter networks are justified, achieving a good amplitude- and phase-equalization with a minimum increase of crosstalk into the luminance channel. Equalization in the video stages and also in the sub-carrier amplifier is considered in detail, illustrated by a block diagram, response curves and waveform oscillograms. The inevitable slight increase in Q-channel cross-modulation is shown to affect colour difference receivers only. In practical tests no obvious colour fringe interference was observed.

A.Landman

621.397.132

# 5856 SOME COLOUR SLIDE AND COLOUR TELEVISION EXPERIMENTS USING THE LAND TECHNIQUE.

W.L.Hughes.

I.R.E. Trans Broadcasting, Vol. BC-6, No. 1, 29-33 (March, 1960).

A series of experiments are described in detail, verifying some of Dr. Land's experiments and showing that although they are not always explainable by classical additive colorimetric theory, certain results are predictable from the standard C.I.E. chart. The colour slide experiments were repeated with a colour television set-up, using a flying-spot scanner and photomultipliers; still observations were confirmed, the difference being in obtaining saturated colours on television, and not reproduction of motion as might be expected. The general conclusions are: (1) colour television will probably remain a three-dimensional medium; although a two-dimensional system could produce a blue, black or yellow, they would not faithfully reproduce the original colours. (2) Land's findings go beyond the classical theory. Complementary colours are simulated by the eye and the mind with no difficulty or even hesitancy. Intensity

variations shift observed colours above or below the complement axis, not only along the axis. (3) The C.I.E. chart, derived from classical colorimetry, is useful in predicting Land colours. (4) Land theory has discovered second-order terms which in many cases, are as important as the first-order classical terms. (5) Colour vision can be regarded as operating with three perceptors with automatic gain controls of finite transient characteristics; such a model is consistent with most Land phenomena. A.Landman

621.397.132

5857 MICROSTRUCTURE INVESTIGATION OF COLOUR TV IMAGES. I.Bornemann.

Nachrichtentechnik, Vol. 9, No. 7, 313-17 (July, 1959). In German. An analysis of raster composition and resolution of the N.T.S.C. system transmission with shadow-mask picture-tube is presented, based on an evaluation of information entropy, undertaken previously by the author and Neidhardt, and extended to colour television. Three items are considered in detail; (a) information reduction due to relationship between spot size and spot brightness; (b) reduction due to the eye's insensitivity to colour in fine detail; and (c) resolution of a three-colour tube in terms of colour dot geometry (triplets). Results show that a genuine increase in picture information is achieved. The paper is illustrated by excellent photo-enlargements of the parts of colour screen images. A.Landman

621.397.132

5858 THE PRACTICAL EFFECTS OF BANDWIDTH LIMITATION ON COLOUR TV IMAGES. P.Neidhardt.

Nachrichtentechnik, Vol. 9, No. 7, 318-23 (July, 1959). In German. A thorough investigation of the transient response of colour receivers is presented, using Fourier analysis and Laplace transforms for the evaluation of a finite-bandwidth amplifier. Idealized colour colour-triangle diagrams are reproduced, plotting chrominance subcarrier vectors of equal phase in a linear N.T.S.C. system and in a non-linear system with a  $\gamma = 2.2$ , leading to the graphic construction of R/Y, B/Y, (R - Y)/Y (B - Y)/Y, I/Y and Q/Y lines, which enable the determination of unit step-function responses for I- and Q-signals and for sudden transition from a saturated colour to black, from white to a saturated colour, and from a saturated to another saturated colour. An experimental set-up for the measurement of transient responses is described briefly, its most important constituents being phase-linear Dietzold filters of substantially flat amplitude response, and adjustable delay networks. The results are interpreted in tables and graphs, comparisons are made between a unit step transition in a monochrome and Y-signal-transition in the N.T.S.C. system, and it is shown that the constant brightness principle applies accurately in stationary conditions only. An attempt to reduce brightness distortion by the circular subcarrier system is only partially successful. An extensive bibliography is appended. A.Landman

621.397.2

5859 SOME PROBLEMS CONCERNING THE EXPERIMENTAL WIRE TELEVISION SERVICE AS REALISED IN THE

NETHERLANDS. A.P.Bolle.

P.T.T. Bedrijf, Vol. 9, No. 3, 75-81 (Nov., 1959). A survey is given of experiments with respect to application of wire television via the existing wire-broadcasting network. The subjects dealt with are: cable characteristics at high frequencies; the necessary alterations of the network configuration; and the choice of frequency band. A description is given of experiments made in an existing wire-broadcasting network. The possibility of simplified receivers is discussed.

621.397.2

5860 RECENT DEVELOPMENTS IN TELEVISION. F.Schröter.

Scientia Electrica, Vol. 6, No. 1, 28-52 (March, 1960). In German. The following fields are reported on: (1) colour transmission: — a physiological-based improvement of the N.T.S.C. system uses pure a.m. of the colour subcarrier by either the red or blue components on alternate lines, signals from each line being reproduced, at the receiver, in the next line by a suitable line-period delay; (2) large screen projection: — an assessment of performance limits for the high potential c.r.t. shows its inferiority compared to the Eidophor system; (3) programme storage: — transverse scanning on magnetic tape is shown to be currently superior; developments in electrostatic-xerographic methods are discussed; (4) wire distribution: — description of a 7-wire p.c.m. transmission system, using a 7-bit electron-beam encoder. Sections 5 and 6 — received picture

storage and frequency-band compression — are interrelated and reported in detail. Progress in the design of c.r.t. storage devices with simultaneous excitation of all picture points, minimum flicker rate and register error, is also instrumental in the solution of band-width economy; velocity modulation of scan speed offers only limited possibilities in this field. Prediction methods based on autocorrelation in the picture sequence are found to be complicated. For TV broadcasting, the a.m. video signal of about 5 Mc/s bandwidth must be reduced to a fraction of this figure: physiological-physiological considerations forecast the practicability of picture-difference transmission within one quarter of the currently used bandwidth, using a high resolution store in the receiver. Further band compression can be realized by means of low-pass filtering in 2 channels with different cut-offs: a comparator assesses the high-frequency content of the original signals and controls an auxiliary deflection of the writing beam in the storage tube, thus producing a crispening effect equivalent to the original bandwidth. 4 references. A.Reiss

621.397.331.22

5861 REACTIVATION OF IMAGE ORTHICONS UNDER LOW TEMPERATURES. B.Wolfe.

I.R.E. Trans Broadcasting, Vol. BC-6, No. 1, 27-8 (March, 1960). A brief description of statistical evidence on reactivation and signal-to-noise improvement of image orthicons, discarded because of excessive "sticking", noise or loss of target. Best results are obtained with tubes which have "rested" 90 days or longer in cold storage. A.Landman

621.397.331.222

5862 PREAMPLIFIERS WITH DRIFT TRANSISTORS FOR VIDICON CAMERAS. H.Anders.

Rdfunktech. Mitt., Vol. 4, No. 2, 66-73 (April, 1960). The choice of the input circuit and the effect of the working point on the signal-to-noise ratio is discussed. This is followed by results of noise measurements made on a fairly large number of transistors of different makes. The best samples attained a signal-to-noise ratio of 26 dB (peak-to-peak) for a signal current of  $0.3 \mu\text{A}_{\text{app}}$ . The spectral distribution of the fluctuations of noise occurring in the transistor preamplifier was analysed by means of a method of measurement based on the principle of search-tone analysis, and a comparison made with that of a valve amplifier. In this connection, an appropriate accentuation of the high frequencies for aperture correction was also taken into account. The measured curves were evaluated by the C.C.I.R. method, in order to embrace the visual interference effect. The relatively great dependence on temperature of the input impedance and the possibility of compensation of the transmission faults resulting from it are discussed.

621.397.6 : 621.317.34

NOISE LEVEL MEASUREMENT IN TELEVISION. See Abstr. 5497

621.397.62 : 621.389

5863 A MEDIUM SCREEN COLOUR (TELEVISION) PROJECTOR. T.M.C.Lance.

J. Televis. Soc., Vol. 9, No. 5, 176-8 (Jan.-March, 1960). The projector gives a 6 ft x 4½ ft picture for industrial television (including medical and educational). The equipment employs "three in line" 4 in. projection tubes each with a Schmidt optical system of f/0.72, geometrical distortions being corrected electrically. Specifications details are given of the projection tube, including phosphor characteristics and information regarding the stabilized glass face. The projector is used with a special lenticular type of screen having a gain of 2.1 and free from colour shading. H.G.M.Spratt

621.397.62

5864 THE ELECTRONICS OF COLOUR TV RECEIVERS. D.Wildgrube.

Nachrichtentechnik, Vol. 9, No. 7, 323-7 (July, 1959). In German. A brief survey of the N.T.S.C. system principles, followed by a description of receiver operation and typical design procedure, emphasizing the novel circuits required for colour separation and demodulation. Convergency and purity adjustments and scanning, e.h.t. and focussing components for the shadow-mask tube are treated in somewhat more detail. Photographs of typical American colour TV receivers are reproduced. A.Landman



- 621.397.621  
5865 IMPROVEMENTS IN TELEVISION RECEIVERS.  
VII. I.F. VIDEO AMPLIFIERS EQUIPPED WITH  
FRAME-GRID TUBES.  
Electronic Applic., Vol. 19, No. 3, 93-114 (1958-59).  
For previous part, see Abstr. 2545 of 1959.

- 621.397.621  
5866 IMPROVEMENTS IN TELEVISION RECEIVERS.  
VIII. THE DESIGN OF FRAME OUTPUT STAGES.  
Electronic Applic., Vol. 20, No. 1, 1-12 (1959-60).  
For Pt VII, see preceding abstract. In this article the operation of the frame output stage is analysed, and formulae for the various quantities are given. By introducing the concepts of "design factor" and "transformer efficiency", the design procedure is greatly simplified. This procedure is first briefly outlined and then illustrated by a detailed example. Particular attention is directed to allowances that must be made to ensure satisfactory operation when the mains voltage drops below its nominal value and when the characteristics of the frame output tube deviate from those of an average tube, for example because it is approaching the end of its life.

- 621.397.621 : 621.318.132  
5867 FERRITE CORES IN HORIZONTAL OUTPUT  
TRANSFORMERS [FOR TELEVISION]. C.Joksch.  
Radio Mentor, Vol. 26, No. 2, 102-7 (Feb., 1960). In German.  
An empirical formula is given for the dependence on frequency and induction of the loss in ferrite cores used in power output transformers for television use, and also a relationship between the temperature coefficient of power loss and the  $\mu_0$ -value. Measurements on ferrite U-cores of U.S.A. and German origin are presented in graphical form for the various characteristics tested, and are used in developing the formulae. The relationships found are discussed and the U-cores in question are compared for characteristic values in a table, which also includes a set of average values based on a ferrite developed by a German manufacturer to strike a compromise between price and properties. W.J.Mitchell

- 621.397.7  
5868 A SPECIAL-EFFECTS AMPLIFIER FOR NONCOMPOSITE OR COMPOSITE, MONOCHROME OR COLOUR  
TELEVISION SIGNALS. R.C.Kennedy.  
J. Soc. Motion Picture Televis. Engrs., Vol. 69, No.3, 166-72 (March, 1960).

Special equipment is described, consisting of an amplifier with very fast "switching" and clamping facilities for versatile processing of non-composite signal (video signal only without sync-waveforms) and composite monochrome and colour signals, designed for the new N.B.C.studios. A full dimensioned circuit diagram of the complete equipment is reproduced and described in detail, illustrated by several waveform oscillograms. A special non-linear ("stretching") amplifier is also discussed, useful for full amplification of the brightness region only. A.Landman

- 621.397.743  
5869 NEW METHODS AND RESULTS OF TELEVISION  
NETWORK PLANNING.  
H.Eden, H.W.Fastert and K.H.Kaltbeitzler.  
Rdfunktech. Mitt., Vol. 4, No. 2, 41-7 (April, 1960).

Describes a method for determining idealized transmitter networks in which mutual interference is as small as possible. The networks may be distorted to fit practical transmitter sites with differing transmitter density by means of "density adaptation". A test is carried out with an idealized, regular network and a family of curves found which shows the connection between the "packing factor" and the network parameters (shared-channel spacing, height of transmitting aerial, effective radiated power). The curves are discussed and their underlying desiderata indicated. By means of the method, frequency plans are worked out for tests on practical networks, which are taken as an example in determining the connection between the degree of coverage and the number of channels necessary. The method remains feasible even when taking into consideration all the auxiliary conditions that are required when working out final frequency plans for practical use.

- 621.397.743  
5870 THE MATHEMATICAL BASES OF THEORETICAL  
TRANSMITTER NETWORK PLANNING. H.W.Fastert.  
Rdfunktech. Mitt., Vol. 4, No. 2, 48-56 (April, 1960).

Endeavours to explain the exact foundation of the method described previously (see Abstr. 4524 of 1960) and to make possible its deeper understanding. After dealing briefly with some basic conception of geometry and the theory of numbers, a theory of linear channel distributions is given. These concepts may be regarded fundamentally as related transformations of linear systems of points. A system of linear channel distributions makes it possible to determine optimum idealized networks for absolute minimum distances or for maximum relative distances.

- 621.397.8  
5871 THE SPECTRAL COMPOSITION OF THE STATISTICAL  
FLUCTUATIONS OF PRESENT-DAY TELEVISION-  
CAMERA INSTALLATIONS. H.Fix and A.Kaufmann.  
Rdfunktech. Mitt., Vol. 4, No. 2, 60-5 (April, 1960).

A search-tone method is used to examine the spectral composition of the statistical fluctuations occurring with known television-camera installations, in the case of a straight amplifier frequency-characteristic and of a phase-corrected accentuation of high frequencies, for the purpose of optimum correction of the resolution loss in the picture tube. Considering the noise evaluating function recommended for the C.C.I.R. 625-line system, and using a comparison method, factors are obtained by means of which the usual peak reading on the oscilloscope must be corrected in order to take into account the subjective impression of interference on the picture screen.

- 621.397.9 : 621.389  
TV TRACKER RECORDS EYE FOCUS POINTS. See Abstr. 5729

- 621.397.9 : 621.389  
THE ULTRA-VOILET FLYING SPOT TELEVISION MICRO-  
SCOPE. See Abstr. 5728

## CONTROL . DATA PROCESSING

## CONTROL AND SERVO SYSTEMS

- 5872 CONTROL ON THE BASIS OF A SELF-ADJUSTING PROGRAMME. I.I. Perel'man. 621-52  
 Avtomat. i. Telemekh., Vol. 19, No. 9, 813-23 (1958). In Russian.

In the usual closed-loop automatic control system containing pure delay the system only reacts satisfactorily to signals having a duration large compared with the delays in the system. The possibility of constructing a system which will provide control with signals both shorter and longer in duration than the delay time is considered. The system is intended only for operation with cycling processes in which the quality of the product may be adjusted at regular intervals. The example taken is control of the thickness of a continuously rolled strip. Variations in the product are classified as either systematic or random. Previous studies have shown that the systematic part of the variation considerably outweighs in importance the random component. The method of control consists of introducing into specific intervals a supplementary excitation which is chosen so as to compensate for a disturbing influence measured at the output of the mill. The compensating programme is derived by collating evidence on the effects of all previous cycles and averaging them out in a kind of synchronous filter. It is stated that the variation in sheet thickness should be reduced by a factor of 3 or 4. [English summary: PB 141096T-8, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.] S.C. Dunn

- 5873 MODIFIED OPTIMUM NONLINEAR CONTROL. 621-52  
 T. Mitsumaki.

Trans. Amer. Inst. Elect. Engrs III, Vol. 78, 10-14 (1960) = *Appl. and Industr.*, No. 47 (March, 1960).

Proposes a new type of control action, "modified optimum nonlinear control", which not only reduces the complexities of the controller but also gives a nearly optimum control, i.e., control action, which is a compromise between theory and practice. The analogue computer study of this control method and its comparison with the discrete compensation techniques in sampled-data control systems are also shown.

- 5874 THE DEVELOPMENT OF AN APPROXIMATELY OPTIMUM SYSTEM WITH THE AID OF AN ELECTRONIC SIMULATOR. R.A. Velershtein and A.A. Fel'dbaum. 621-52  
 Avtomat. i. Telemekh., Vol. 19, No. 9, 824-35 (1958). In Russian.

The control system required for a rolling mill is first divided into a convenient number of blocks; by this means the method of synthesis proposed by Silva (Abstr. 3074 of 1954) can be applied to build up an optimum system from elements of optimum configuration but of lower order. The proposed control system consists of a micro-meter followed by an electronic amplifier feeding an electromechanical amplifier. The output of the latter excites a generator which feeds the main rolling-mill motor. The system was first examined on a non-linear simulation and it was found that compared with a linear control system the regulation time was reduced by a factor of 2.6 and the effective bandwidth of the system was approximately doubled. When the effects of backlash and time delay are further considered the improvement in regulation time is still as much as 2.4 but the controlling action itself is less satisfactory. [English summary: PB 141096 T-8, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.] S.C. Dunn

- 5875 DETERMINATION OF THE PERIODIC BEHAVIOUR IN AUTOMATIC CONTROL SYSTEMS HAVING A NON-LINEAR ELEMENT WITH A PIECE-WISE LINEAR CHARACTERISTIC. L.A. Gusev. 621-52  
 Avtomat. i. Telemekh., Vol. 19, No. 10, 931-44 (1958). In Russian.

The system behaviour is expressed as a complete Fourier series within each segment of the non-linear characteristic. The problems of matching solutions at each boundary of a linear segment are discussed. The problem involves the solution of a system of transcendental equations for which a computer is really necessary. S.C. Dunn

- 5876 CALCULATION OF TRANSIENTS IN LINEAR CIRCUITS USING RECURRENCE FORMULAE. N.S. Kochanov. 621-52  
 Elektrichestvo, 1960, No. 4, 70-2 (April). In Russian.

A feature of this method is the fact that the transient functions of linear circuits are calculated by means of recurrence formulae from exact initial values of these functions, so that the error is reduced to a minimum. An example of such a calculation is appended.

Associated Electrical Industries (Manchester)

- 5877 THE STABILIZATION OF CONTROL SYSTEMS WITH BACKLASH USING A HIGH FREQUENCY ON-OFF L/O.P. 621-52  
 E.A. Freeman.

Proc. Instn. Elect. Engrs, Monogr. 356 M, publ. Feb., 1960 (Vol. 107C, 150-7, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 1045 of 1960.

- 5878 THE EXISTENCE OF A CYCLE BEYOND THE CONDITIONS FOR ABSOLUTE STABILITY OF A THREE-DIMENSIONAL SYSTEM. B.V. Shirokorad. 621-52  
 Avtomat. i. Telemekh., Vol. 19, No. 10, 953-67 (1958). In Russian.

Starting from the equations of a simplified automatic control system as specified by Letov, it is shown that apart from the conditions of absolute stability, there always exists in addition a non-trivial (and in particular, periodic) stable regime. The stability is also considered according to the criteria of Lagrange and Lyapunov. Two examples are given of a physical interpretation of the system of equations. The first is the motion of an aircraft and the second is the stability of a single-valve tuned-grid oscillator. The formulae deduced enable an estimate of the limits of adjustment of the transfer conditions of an automatic system, and of the amplitudes of the possible oscillations in practical cases. English summary: PB 141096 - 11, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A. S.C. Dunn

- 5879 THE STABILITY OF A PARTICULAR CONTROL SYSTEM. J. Tschauner. 621-52  
 Regelungstechnik, Vol. 7, No. 7, 247-8 (July, 1959). In German.

A control system in which the regulating unit has a definite undamped frequency and where the signal transmission is continuous is frequently unstable. The present investigation, however, proves that the same system will become perfectly stable if the signal transmission is made intermittent. It is thus demonstrated that intermittent signal transmission (impulse regulation), under certain conditions, is a suitable means for improving the stability of a control system.

- 5880 THE STABILITY OF SAMPLED-DATA SYSTEMS. 621-52  
 J. Tschauner.

Regelungstechnik, Vol. 8, No. 2, 42-6 (Feb., 1960). In German.

Different stability criteria are generally applied to sampled-data systems compared to those for continuous systems, since the former receive input data in the form of consecutive impulses with equal time intervals  $T$  ( $T$  = impulse period). A simple, easily understandable derivation of stability criteria for sampled-data systems of any order, employing root locus methods, is presented. Three stability criteria result which, taking into consideration a few secondary conditions, are necessary and sufficient for the stability of a sampled-data system of any order.

- 5881 THE TREATMENT OF NON-LINEAR PROBLEMS IN CONTROL TECHNOLOGY. P.J. Nowacki. 621-52  
 Regelungstechnik, Vol. 8, No. 2, 47-50 (Feb., 1960). In German.

A brief comparison is given of existing methods for the treatment of non-linear control problems. It is shown how, by way of iteration, the Laplace transform can also be applied for the solution of non-linear problems. A new method of approximation is explained according to which a series of linear sections is substituted for the non-linear function. The resulting approximations are compared with those obtained by the method of differences.

- 621-52  
**5882 MAGNETIC SYSTEMS IN CONTROL TECHNOLOGY.** H.Bley.  
*Regelungstechnik*, Vol. 8, No. 2, 51-5 (Feb., 1960). In German.  
 A survey of amplifying elements which operate on the principle of magnetic saturation. The investigation comprises discontinuous, quasi-continuous and continuous controllers.
- 621-52  
**5883 TERMINOLOGY, PROBLEMS, METHODS AND AUXILIARIES OF OPEN-LOOP CONTROL TECHNIQUES.** H.Kaltenecker.  
*Regelungstechnik*, Vol. 8, No. 3, 73-8 (March, 1960).  
 A general survey of open-loop control techniques, an introduction to the relative terminology and some of the problems involved. It is shown how to design an open-loop control system and the functional elements and also the equipment used are described. More detailed information on open-loop control systems is supplied, particularly in the field of process control. 49 references.
- 621-52  
**5884 THE SIMATIC SYSTEM - A NEW DEVELOPMENT FOR CONTROLS.** H.Zenneck and M.Tschermak.  
*Siemens - Z.*, Vol. 33, No. 10, 593-8 (Oct., 1959). In German.  
 As a switching element, a transistor affords a number of advantages over a contact. These advantages are made use of in the contactless Simatic system. The system consists of a series of components which perform basic control functions as described. Difficult control problems can be solved by combining these components.
- 621-5  
**5885 PROBLEMS IN THE DESIGN AND MANUFACTURE OF THE SIMATIC SYSTEM.** U.Hruschka and H.J.Krimmling.  
*Siemens - Z.*, Vol. 33, No. 10, 612-17 (Oct., 1959). In German.  
 The Simatic system consists of a range of components which serve as switching elements but do not employ contacts. The external shape of the components is in each case the same. A description is given of their mechanical construction, the possible methods of connecting them up and of their assembly into control systems. Also illustrated is the method of testing the switching elements and the components.
- 621-52  
**5886 INERTIAL-GUIDANCE LIMITATIONS IMPOSED BY FLUCTUATION PHENOMENA IN GYROSCOPES.** G.C.Newton, Jr.  
*Proc. Inst. Radio Engrs*, Vol. 48, No. 4, 520-7 (April, 1960).  
 The performance limitation imposed by thermal fluctuations in gyroscopes is examined. This is done because experience in electronics shows that thermal noise is the ultimate performance limitation in sensitive instruments such as radio receivers and galvanometers. It is found that a system limited only by thermal noise in its gyroscopes would have several orders of magnitude more precision than that indicated in published performance data. This must mean that other factors are limiting performance of gyroscopes, and investigation of several of these shows that bearing noise may be an important one. In conclusion, since gyroscopes do not yet come near to attaining the performance limits set by thermal noise, there may be much room left for their further improvement.
- 621-52  
**5887 ATTITUDE REFERENCE DEVICES FOR SPACE VEHICLES.** P.E.Kendall and R.E.Stalcup.  
*Proc. Inst. Radio Engrs*, Vol. 48, No. 4, 765-70 (April, 1960).  
 Presents the design features of an attitude sensing device which is quite compact and should prove to be reliable. The original objective in the design was to provide a simple means of establishing a vertical reference line from an orbiting space vehicle to a planet under observation. It has been accomplished through the use of two narrow infrared scanning beams. The centre line of each beam rotates at constant angular velocity in a plane, the plane of one beam being perpendicular to that of the other. The active portion of the scan is 270° for each beam. When the scanner intersects the planet, a step in the signal level occurs. Position of the beam when the half width of the signal step occurs establishes a plane which contains the centre of the planet. Intersection of the two such planes generated by the dual scanner is the direction to the planet local vertical.
- The assembly is described in detail. Further, by using analogue computer techniques, it is shown that pitch and roll angles about this vertical reference line can be generated. A single degree of freedom gyro can be added to the equipment to produce yaw information in the case of an orbiting vehicle. Finally, a method for measuring altitude is discussed.
- 621-52 : 525  
**5888 PERFORMANCE, CONTROL AND GUIDANCE OF SATELLITE VEHICLES.** A.W.Lines.  
*Proc. Roy. Soc. A*, Vol. 253, 500-11 (Dec. 29, 1959).  
 Space Research Discussion, London, 1958 (see Abstr. 3780 of 1960). A consideration of steps which could be taken to increase the scientific value of satellites. The control of satellite orientation and the realization of orbits specified within narrow limits are discussed. It is emphasized that the satellite-rocket system should be considered as a single entity in order to achieve optimum performance, the rocket stages, satellite and their equipments being considered as a single entity. C.Hazard
- 621-52 : 621.34  
**5889 OPTIMUM CONTROL SYSTEMS FOR THE FLYING SHEARS DRIVE IN A ROLLING MILL.** S.M.Domanitskii.  
*Elektrichestvo*, 1960, No. 1, 27-33 (Jan.). In Russian.  
 The main theoretical principles involved are examined and some optimum control systems are described. Details are given of experimental investigations on some optimum systems using models. Associated Electrical Industries (Manchester)
- 621-52 : 621.791.76  
**SELF-ADJUSTING CONTROL SYSTEM FOR ELECTRIC PIPE-WELDERS.** See Abstr. 5942
- 621-528  
**5890 APPROXIMATE DETERMINATION OF TRANSIENT REGIMES IN NONLINEAR SERVOS.** B.N.Naumov.  
*Automatisme*, Vol. 5, No. 4, 133-9 (April, 1960). In French.  
 A translation of a Russian paper by the author. The principle propounded is based on the trapezoidal method of calculating the integral of convolution. The difficulties encountered when this method leads to a solution in terms of discontinuous impulses are resolved. An essentially numerical approach is made to the problem of dealing with nonlinear systems of order higher than the second (i.e. where phase plane fails). The treatment is very general in character, but examples of application are given. T.Horrocks
- 621-526  
**5891 A "Z-TRANSFORM-DESCRIBING-FUNCTION" FOR ON-OFF TYPE SAMPLED-DATA SYSTEMS.** B.C.Kuo.  
*Proc. Inst. Radio Engrs*, Vol. 48, No. 5, 941-2 (May, 1960).  
 Shows how to derive a describing function using the Z-transform for the case where the non-linear element includes only the on-off relay of the system. The function is of use for (1) systems with or without zero-order hold circuit; (2) finite pulse-width consideration with flat-topped approximation; and (3) systems with more than one synchronized sampling switch. G.D.Sims
- 621-526  
**5892 A NOTE ON THE STEADY-STATE RESPONSE OF LINEAR TIME-INVARIANT SYSTEMS TO GENERAL PERIODIC INPUT.** E.I.Jury.  
*Proc. Inst. Radio Engrs*, Vol. 48, No. 5, 942-4 (May, 1960).  
 Gives a simple procedure for obtaining the steady-state response of linear systems to non-sinusoidal periodic inputs, by applying the final-value theorem to the modified Z-transform of the output. G.D.Sims
- 621-526  
**5893 INCREASING THE DYNAMIC TRACKING RANGE OF A PHASE-LOCKED LOOP.** C.S.Weaver.  
*Proc. Inst. Radio Engrs*, Vol. 48, No. 5, 952-3 (May, 1960).  
 The transient response and the effective noise bandwidth of a phase-locked loop are related to the dynamic tracking range. It is shown that for a slowly varying frequency the latter may be adjusted without making a large difference to the first two. T.Horrocks



621-526

- 5894 THE EFFECT OF AN ADDITIONAL NON-LINEARITY ON THE PERFORMANCE OF TORQUE-LIMITED CONTROL SYSTEMS SUBJECTED TO RANDOM INPUTS. J.L.Douce and R.E.King. Proc. Instn Elect. Engrs, Monogr. 361 M, publ. Feb., 1960 (Vol. 107C, 190-7, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 1925 of 1960.

621-526

- 5895 A CALCULATION OF SWITCHING FUNCTIONS AS A MEANS OF MINIMIZING ERROR IN AN ON-OFF CONTROL SYSTEM. R.F.Brown. Proc. Instn Elect. Engrs, Monogr. 370M, publ. Feb., 1960 (Vol. 107C, 249-56, Sept., 1960).  
 Republication of the Monograph already abstracted as Abstr. 3184 of 1960.

621-526

- 5896 ON THE STABILITY OF CONTROL SYSTEMS WITH QUADRATIC DEPENDENCE IN THE PI CONTROLLER. R.Herschel. Regelungstechnik, Vol. 7, No. 7, 240-6 (July, 1959). In German.  
 The systems discussed are those in which the control function has terms proportional to the error  $x$  and to the integral of error. The coefficients of the terms are  $\rho_0 = r_0 + bx^2$  and  $\rho_{-1} = r_{-1} + cx^2$  respectively. By differentiation new coefficients  $\alpha$  and  $\alpha^*$  of similar form are obtained, and two different relations between them are derived, which enable R and A curves to be plotted on the phase plane. The A curves are straight lines, while the R curves depend on the order of the system. The stability conditions can be studied from the way in which the A curves intersect the R curves, and the coefficients  $b$  and  $c$  which are found. The practical limitations are increasingly severe as the order of the system increases, but it is shown that, in a limited range, an unstable linear system can often be stabilized by the introduction of non-linearities. W.G.Stripp

621-526

- 5897 ON A METHOD OF OPTIMUM CONTROL OF SYSTEMS WITH DEAD TIME. H.Schliessmann. Regelungstechnik, Vol. 7, No. 12, 418-21 (Dec., 1959). In German.  
 It is shown that in a proportional controller with dead time  $t_0$ , a step output perturbation can be corrected in the dead time by adding a feedback loop which simulates the controlled plant. However, the method is very sensitive to changes of system parameters, particularly of gain ratio and time-constant ratio in the controller and feedback loop, and is not suitable for optimum control. W.G.Stripp

621-526

- 5898 ON THE INDEPENDENT (CONTROL) OF FREQUENCY AND VOLTAGE AND THE STABILITY OF AN AUTOMATIC REGULATOR CONTROLLING A SINGLE SYNCHRONOUS GENERATOR. D.P.Petelin. Avtomat. i Telemekh., Vol. 19, No. 9, 864-78 (1958). In Russian.  
 The basic system of regulation consists of speed control of the driving motor from a tachometer and of voltage control by measurement of the output voltage via a three-phase rectifier, each through its own electronic amplifier and amplidyne. The paper investigates in considerable detail the transient performance of the two parts of the system and the interaction between these parts. By introducing cross compensation between the two circuits controlling frequency and voltage, independent control of each of the quantities can be obtained. As well as the equations relating the various time constants, Nyquist diagrams and oscillograms of response for different parts of an experimental model are given. [English summary: PB 141098T-8, obtainable from Office of Technical Services, U.S. Dept. of Commerce Washington, D.C.]. J.S.Wilson

621-526 : 621.313.333

- TWO-PHASE INDUCTION MOTOR USED AS A SERVO MOTOR. See Abstr. 5360

## TELECONTROL . TELEMETERING

621.398 : 621.311.21

- 5899 REMOTE CONTROL OF DUFFERIN FALLS GENERATING STATION. W.S.Watson and V.Gabruss. Engng J., Vol. 43, No. 5, 68-72 (May, 1960).  
 This station with two 22.5 MVA sets in Buckingham, Quebec, is operated from the Masson switching station 3 miles away over a carrier-current link, using a duplex double-side-band amplitude-modulated system. Power output and headwater level are telemetered continuously; the kWh-meter operates through an impulse storage system. A unit creep detector and headgate shearpin alarm are provided. The saving in operators will pay for the control equipment cost within two years. P.Linton

621.398

### ELECTRONIC REMOTE CONTROL SYSTEM.

- 5900 A.Muschik and G.Pumpe. Siemens-Z., Vol. 33, No. 8, 486-92 (Aug., 1959). In German.  
 The novel electronic control system here described uses a binary code with special safeguards against false signals. The equipment is transistorized. The system allows progressive expansion and is suitable for the solution of control and return indication problems encountered in power distribution industry, transportation, but will find preferential use for transmission problems where the conservation of copper and spectrum space is a factor. The individual control signals and return indications are so short that they may be cut into telephone conversations unnoticed at telegraph speeds around 800 bauds; transmission at a lower speed over carrier telegraph channels is also possible.

621.398 : 621.221.4

- 5901 SUPERVISORY AND AUTOMATIC CONTROL SYSTEM FOR WINNIPEG UNATTENDED PUMPING STATION. J.W.MacLaren, D.J.Moon, W.D.Hurst and F.G.Denson. Engng J., Vol. 43, No. 4, 76-82 (April, 1960).

The extended Winnipeg water supply system is fed by a new pumping station drawing from a large reservoir and incorporating accurate pressure control over the entire flow range. The equipment comprises two electrically-driven constant-speed 600 h.p. pumps and 3 variable-speed 400 h.p. pumps driven either by an induction motor through a scoop-controlled fluid coupling or by a variable-speed gas engine under emergency and peak load conditions. The automatic control system operates on station flow and maintains the pressure at  $75 \pm 2.5$  lb/in<sup>2</sup> over the range 0-36 m.g.d. by selecting the correct pump combination and speed. The 18-channel supervisory system operates over a single telephone circuit.

P.Linton

621.398 : 621.311.1

- 5902 REMOTE CONTROL AND SUPERVISION OF SUPPLY INSTALLATIONS IN COUNTRY DISTRICTS. H.Bockelmann. Elektrizitätswirtschaft, Vol. 59, No. 5, 118-24 (March 5, 1960). In German.

The supply installation of a predominantly rural district has two characteristics. Firstly, the network density is low. Secondly, there are few communication circuits available to interconnect supply points for the efficient supervision and control of the network. Radio circuits must be used for remote control over the longer distances and this has led to the installation of radio control centres. Experiences are described which were gained in the five years from 1954, during which radio control methods were in regular use in a large rural supply area, that of Schleswig-Holstein. The installation and equipment used are described in some detail, as are the methods of working. A frequency-modulation technique was employed with various audio frequencies set aside for particular purposes. E.W.Golding

621.398

### INTERPLANETARY TELEMETERING.

- 5903 R.H.Diamond. Proc. Inst. Radio Engrs, Vol. 48, No. 4, 679-85 (April, 1960).  
 The problem areas associated with interplanetary telemetry and an approach to the selection of system operating parameters are discussed. The analysis is based on the dividing of operational efficiency into two categories: information efficiency and physical system efficiency. The performance of a typical interplanetary system is analysed to exemplify the importance of a number of the operating parameters which affect system performance.

# 5904 SPACE TELEMETRY SYSTEMS.

W.E. Williams, Jr.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 685-90 (April, 1960).

Presents some of the problems which are faced in the field of space telemetry, and gives a few examples of the approaches used in attempts to solve these problems to date. The different types of information to be transmitted back to receiving stations on the earth from satellites and space probes are discussed. The telemetry systems which have been used in various experiments of this type are described, along with some typical performance figures for some past payloads. A discussion of the problems to be faced in future experiments is also included.

621.398

# 5905 SIGNAL-TO-NOISE CONSIDERATIONS FOR A SPACE TELEMETRY SYSTEM.

R.W. Rochelle.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 691-3 (April, 1960).

A signal-to-noise comparison is given between the pulse-frequency channels and the pulse-width channels for the f.m./p.d.m.-a.m. telemetry system. It is shown that the pulse-frequency channels have either a higher signal-to-noise ratio or greater information rate capability than the pulse-width channels.

621.398

# 5906 TELEMETRY BANDWIDTH COMPRESSION USING AIRBORNE SPECTRUM ANALYZERS.

A.G. Ratz.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 694-702 (April, 1960).

In practice, most missile test signals requiring wideband telemetry channels are high-frequency random signals obtained from vibration accelerometers, etc. However, their information content is contained in their slowly-varying statistical parameters. The unique problems associated with extracting the spectral density plot of high-frequency random signals (one of the most useful of the statistical parameters), and then presenting this to the telemeter are considered. Design formulae are derived showing the interrelationship between the parameters of the random signal and the characteristics of the telemetry. Formulae indicating the tremendous improvement in bandwidth efficiency are also given.

621.398

# 5907 THE TELEMETRY AND COMMUNICATION PROBLEM OF RE-ENTRANT SPACE VEHICLES.

E.F. Diers.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 703-13 (April, 1960).

The problems associated with propagation of electromagnetic telemetry and communication (and guidance) signals through the densely ionized region (plasma) generated by, and surrounding a hypersonic space vehicle re-entering the earth's atmosphere are reviewed. The nature and extent of the plasma-radio wave interference is explained in terms of the classical treatments which have evolved from ionospheric studies. The limitations of the simple classical models are pointed out in the light of the more complex nature of the hypersonically generated plasma. Methods for overcoming the deleterious influences of the plasma are presented, culminating in presentation of some new approaches to this problem.

621.398 : 621.396.946

MEASUREMENT OF PHYSIOLOGICAL FACTORS FOR A PERSON UNDERGOING VIGOROUS PHYSICAL EXERCISE. See Abstr. 5724

621.398 : 621.389

## COMPUTERS . APPLICATIONS

(Refer also to Digital circuits . Switching circuits)

# 5908 PROGRAMMING THE I.B.M. 704 COMPUTER FOR PHOTOMETRIC DATA REDUCTION, DOCUMENTATION AND APPLICATION.

A.B. Gough.  
Illum. Engng, Vol. 55, No. 4, 203-14 (April, 1960).

An I.B.M. 704 is used to calculate results of photometric tests of outdoor lighting floodlights according to the I.E.S. method. The tests, on an automatic photometer, comprise a 12 by 12 array of points, and the computer programme, for which a block diagram is given, gives the total beam lumens, beam efficiency, beam width, point by point candlepower and lumen values, maximum and average maximum candlepower values, and an isocandle plot which is produced on a cathode-ray tube and photographed automatically. Such

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a run takes just under two minutes. The problem of aiming a number of floodlights to illuminate a football field in the most uniform manner is also considered and a block diagram of a feasible computer programme to solve it given. However, test runs show that this programme is uneconomic.

G.A. Montgomerie

681.142

# 5909 TRANSFORMER DESIGN WITH THE DASK (DANISH COMPUTER).

O.I. Franksen.  
Ingeniøren B, Vol. 69, 313-21 (May 15, 1960). In Danish.

A 3-year design programme for power transformers is described. It comprised 7 subsidiary programmes and 10 000 machine instructions. The customer's specifications such as windings, voltage, frequency, are combined with designer's parameters such as core characteristics, current density, leading to the complete machine design. Examples are given showing the programming for the determination of temperature of the winding over oil, d.c. resistance and stray loss and cross-section in an axial-radial direction of a h.v. disk winding.

G.N.J. Beck

681.142 : 621.316.11

DIGITAL SOLUTION OF SHORT-CIRCUIT CURRENTS FOR NETWORKS INCLUDING MUTUAL IMPEDANCES. See Abstr. 5414

681.142 : 621.316.11

NEW METHOD OF MAKING TRANSMISSION LOSS FORMULAE DIRECTLY FROM DIGITAL POWER FLOW STUDIES. See Abstr. 5413

681.142 : 621.315.11

PLANNING IN MEDIUM-VOLTAGE SUPPLY SYSTEMS WITH THE HELP OF THE DIGITAL COMPUTER. See Abstr. 5412

681.142 : 621.313.333

THE CALCULATION OF SHADED POLE MOTOR PERFORMANCE BY THE USE OF A DIGITAL COMPUTER. See Abstr. 5361

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# 5910 THE ROLE OF ELECTRONICS IN DATA-PROCESSING METHODS.

P. Neidhart.  
Nachrichtentechnik, Vol. 10, No. 5, 191-5 (May, 1960). In German.

681.142

# 5911 THE OPTIMUM RECORD LENGTH IN AN I.B.M. 650-TAPE SYSTEM.

P.L.M. Van Berkel and P.J.A. Van Der Ham.  
P.T.T. Bedrijf, Vol. 9, No. 3, 82-98 (Nov., 1959).

An investigation was carried out to consider the optimum record length for grouped records in an I.B.M. 650-tape system. It appears that the maximum record length of 60 words is not necessarily the optimum length, because of the access time to the magnetic drum where the record is to be stored and looked up. The optimum record length proves to be to a high degree independent of the number of items per record. Because of the maximum permissible record length of 60 words this investigation applies only to short records as used in banking and clearing operations. The merging of tape records in the immediate access storage with different types of item, such as transfers, cheques and deposits, is considered. A theorem is presented for determining the optimum utilization of a core memory.

681.142 : 621.311.1

# 5912 TRANSIENT STABILITY STUDIES. III. IMPROVED COMPUTATIONAL TECHNIQUES.

L.J. Rindt, R.W. Long and R.T. Byerly.  
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1673-7 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

For Pt II, see Abstr. 3930 of 1959. Deals with the development and early use of a digital computer programme for solving transient stability problems for electric power systems. The approach used depends on the reduction of the system network to an equivalent containing only essential buses. A previous paper described a programme based on matrix concepts for reducing a network. This new programme, which reduces a network a bus at a time, has shown itself to be considerably faster and capable of handling larger systems. A brief outline of the analytical basis for the programme is given together with a description of the programming techniques employed.

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# 5913 AN ANALOG AND DIGITAL AIRBORNE DATA ACQUISITION SYSTEM.

D.H. Ellis and J.M. Walter, Jr.  
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 713-24 (April, 1960).

The acquired data is recorded on one-inch tape. The format may

be fourteen tracks of analogue or seven tracks of analogue with sixteen tracks of digital data. Amplex AR-200 equipment is used on the analogue subsystem. Complete analogue system reference data are recorded on one track. The digital system has extreme flexibility. From ten to ninety channels may be programmed for individual word rates of from 1.25 samples to  $2 \times 10^5$  samples/sec. System word rates are 30, 10, 5, and 2.5 kc/s. The analogue-to-digital converter performs up to  $2 \times 10^4$  conversions/sec, depending on the selected sampling rate of the multiplexer. Time-history and system marker data are also recorded. Provision for acceptance of Gray code digital input data has been made. The input on any channel may be low-level ( $\pm 10$  mV full scale) or high-level ( $\pm 5$  V full scale). Signal conditioning and automatic calibration are provided. Multiplexer channel capacity can be extended by the addition of more modules. Flexibility of programming is provided with pluggable programme boards. The system is designed using all transistorized components and is constructed to withstand vehicular environmental extremes. Detailed descriptions of the low-level gate circuit, programming, accumulating, and coding techniques are made.

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- 5914 ON THE ANALOG-DIGITAL SOLUTIONS OF POWER SYSTEM STABILITY. S. Das Gupta.  
J. Technol. (Calcutta), Vol. 4, No. 1, 63-86 (June, 1959).

Outlines computational techniques for the determination of (a) generator terminal conditions, and (b) conditions at points within the system by means of a digital-analogue method. Accurate representation of the system conditions is not feasible when the network-analysar method of solving the transient stability is employed. The method becomes quite uneconomic when an accurate representation of conditions such as d.c. loss, etc. are to be simulated. A computation technique to determine the effect of d.c. losses in such studies is outlined.

681.142

- 5915 ON THE MEASUREMENT OF THE PRODUCT OF AN IMPULSE COUNT AND A VARIABLE QUANTITY.  
R. Giersiepen and F. Wenzel.  
Arch. tech. Messen, No. 290 (Ref. J 082-7), 53-4 (March, 1960). In German.

The paper describes a method for electrically multiplying two quantities. One of these is represented as the aggregate number of a train of impulses, and the other, which is assumed to be slowly varying in comparison with the first, is represented by a voltage. The actual multiplication is done by potential dividers. The input potential represents the slowly varying quantity and the setting of the divider is achieved by means of a stepping, or counting relay, actuated by the incoming pulses. The output then represents at any instant the product of the slowly varying magnitude and the aggregate count. Various practical considerations are given, and an actual apparatus for use with a gas analyser is described.

A.E.I. Research Laboratory

681.142

- 5916 PRECISION MULTIPLIER.  
L.N. Fittsner.

Avtomat. i Telemekh., Vol. 20, No. 1, 62-9 (1959). In Russian.  
In the described multiplier a distributor divides the applied voltage into the basic part, which can only have one of several predetermined discrete values, and the residual voltage. The basic part of the voltage is applied to the coarse multiplier and is subject to multiplication with the multiplicand. The residual voltage is applied to the fine multiplier where it is first amplified  $k$  times, multiplied with the multiplicand and then reduced in value  $k$  times. Outputs of both coarse and fine multipliers are added in an operational amplifier with automatic zero adjustment. The error of the entire multiplier is approximately equal to the error of its fine part, is about  $k$  times smaller than errors of the usual multipliers, and in practice does not exceed 0.01-0.02%. Block diagrams of the multiplier are shown and discussed.

J.M. Silberstein

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- 5917 COMPUTING AMPLIFIER WITH DIFFERENTIAL INPUT. V.B. Smolov.

Avtomat. i Telemekh., Vol. 19, No. 12, 1145-9 (1958). In Russian.  
A block schematic of an amplifier is considered. With the aid of special input and feedback circuits this amplifier may be used to represent the majority of practical integro-differential relationships. It can also perform the majority of the usual mathematical operations without obtaining in the process a sign inversion. Tables showing the circuits for specific operations are given.

T. Horrocks

# THE ELECTRONIC ANALOGUE COMPUTING INSTALLATION AT ILMENAU E.A.R.I.

H. Winkler and D. Schreier.

Nachrichtentechnik, Vol. 9, No. 10, 437-41 (Oct., 1959). In German.

The machine which contains 400 valves and consumes 2.5 kW can operate either repetitively at frequencies of 5, 10 or 20 c/s or can operate as a simulator in real time. Among the disposable components are two compensated measuring instruments, three function transformers, three function generators giving limiting and dead zone, sixteen operational amplifiers which may be used either for multiplication by a constant or integration, seven summing points, seven potentiometer multipliers, seven inverter-multipliers, five electronic function multipliers, three oscillographic function generators with photocell following and three patching panels. The general features of all the known kinds of multiplier are carefully examined and the reasons put forward for the choice of the method adopted, namely a quarter-squares unit.

S.C. Dunn

681.142

- 5919 THE SERVO LABORATORY'S ANALOGUE COMPUTER. SPECIAL CALCULATING UNITS AND RECORDING EQUIPMENT. P. la Cour Christensen.

Ingeniøren B, Vol. 69, No. 9, 295-8 (May 1, 1960). In Danish.

To improve the accuracy and efficiency of the analogue computer built in 1958 (see Abstr. 3500 of 1958), it has been provided with the following auxiliary equipment: (1) thirty standard plug-in coupling units, each with four inputs; (2) two diode function generators to enable more complicated non-linear functions to be fed in; (3) a time delay network consisting of 131 half-normal  $\pi$ -networks and two double  $m$ -derived terminal networks (max. delay 10 ms and the corresponding attenuation 8.3 dB); (4) a time transformer. Since no recorder exists which can operate with an accuracy comparable with that of the computer, a special circuit was constructed which can "time-transform" a periodic voltage, i.e. it can reproduce the rapidly changing voltage on a slow time scale. The transformer output can then be recorded on a potentiometer recorder.

G.N.J. Beck

681.142

- 5920 AN ELECTRONIC PERFORATED TAPE READER AND DIGITAL-ANALOGUE CONVERTOR.  
P. la Cour Christensen.

Ingeniøren B, Vol. 69, No. 9, 299-302 (May 1, 1960). In Danish.

Perforated tapes can be used to generate time functions on a chosen time scale. The equipment described is essentially a function generator and is used partly for the control of perforated tapes and partly to generate time functions. With it 2-digit numbers can be read off and transformed at a speed of 1-1000 figures/sec. The tape reader uses a phototransistor circuit, the operation of which is described. The digital-analogue convertor uses flip-flop circuits between reader input and the summing amplifier, there being four parallel channels. A block diagram is shown.

G.N.J. Beck

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- 5921 METHOD OF INVESTIGATING DYNAMIC STABILITY ON ANALOGUE COMPUTERS. V.S. Tarasov.  
Elektrichestvo, 1960, No. 4, 7-12 (April). In Russian.

Explains some features of methods used to investigate transient phenomena in two synchronous machines operating in parallel with a network of infinite capacity across lumped resistances. Full details are given of the equations used for this investigation and the method of setting up the problem on an analogue computer. The method can also be used for a number of other problems.

Associated Electrical Industries (Manchester)

681.142 : 621.311.25

- 5922 TRAINING SIMULATOR FOR NUCLEAR POWER PLANT OPERATOR. N.E. Bush.

Trans. Amer. Inst. Elect. Engrs III, Vol. 78, 1482-6 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

Designed to simulate the operation of the N.S. Savannah power plant, the simulator consists mainly of a 70-amplifier general purpose analogue computer with outputs in the form of reactor instrumentation mounted on a realistic control console. Description is non-theoretical, although a comprehensive simulation block diagram is given with inscribed transfer functions.

K.C. Garner



681.142

### 5923 AN AUTOMATIC CORRELATOR. J.Křečan.

Slaboproudý Obzor, Vol. 21, No. 4, 214-19 (1960). In Czech.

General description (with block schematics) of an original automatic correlator is given. The instrument consists of an input circuit, a multiplication circuit, an integrator and the output (or read-out) device. The functions  $f_1(t)$  and  $f_2(t + \tau)$  which are to be correlated, are pulse-frequency and pulse-width modulated and then recorded on magnetic tapes of the input circuit. The product of the two functions thus modulated is obtained in the multiplier which is based on trigger and gating circuits. The two outputs of the multiplier are applied to two counters which record the difference between the number of pulses at the outputs. The result is periodically printed on a paper tape in digital form. The result can also be read in analogue form; for this purpose the outputs of the multiplier are fed to two RC integrators which are connected to a difference circuit. The difference is read periodically and recorded on tape in the form of a vertical line. The equipment is suitable for the frequencies up to 100 c/s.

R.S.Sidorowicz

681.142 : 621.316.718.5

### 5924 ANALOGUE SIMULATION FOR THE SPEED CONTROLLER OF THE LATINA POWER STATION CO<sub>2</sub> BLOWERS.

E.Torielli, M.De Bacci, V.Gervasio and C.Zaffiro.

Energia nucleare, Vol. 7, No. 5, 333-41 (May, 1960).

The CO<sub>2</sub> cooling circulation system consists of two speed-controlled turbines driving a pair of alternators which are paralleled to supply power to six asynchronous motor-driven blowers. Because of the preset 7.1% droop characteristics of the alternators the system can be considered to be symmetrically divided into a turbo-alternator and three motors in each half. A hydromechanical P + I controller is used which has an electrically varied set-point input. The main purpose of the simulation, details of which are shown schematically, is to determine the system transient response over its expected operating range, and to design a cam which shapes the steam admission to the turbines to give a uniform and optimum response throughout the range. The transfer functions for the individual units are developed, and the root-locus method is used in the cam design. Results are given graphically.

K.C.Garner

## MECHANICAL AND CIVIL ENGINEERING TECHNOLOGY

621.9.018.5

### 5925 AVOIDANCE OF ARCS IN THE SPARK EROSION PROCESS. H.H.Rust.

Elektrotech. Z. (E.T.Z.) B, Vol. 12, No. 6, 125-7 (March 21, 1960). In German.

Arc formation is detrimental in that it leads to negligible erosion rate. It is shown that this can be largely avoided by the use of a waveform which reduces the voltage to zero once per cycle.

E.A.Ash

620.179.16

### 5929 THE USE OF ULTRASONICS IN THE TESTING OF IRRADIATED FUEL ELEMENTS. J.M.Fouts.

A.S.T.M. Bull., No. 242, 60-2 (Dec., 1959).

An underwater flaw detector for examining the bond between the outer aluminium sheath and uranium slug of fuel elements is described. The slug is placed on rotating rollers and scanned by a single quartz transducer disk 0.375 inch diam.  $\times$  0.006 inch thick operating at 20 Mc/s at a p.r.f. of 3 000 per sec. acting as both transmitter and receiver. The differences between echoes for bonded and unbonded interfaces (as seen on an oscilloscope) are explained. It is hoped to correlate the bond stability with localized hot areas found on irradiated slugs.

A.P.C.Thiele

## MATERIALS . TESTING

620.172.2

### 5926 USE OF RESISTANCE STRAIN GAUGES. K.G.Mantle and E.Procter.

Engineer, Vol. 209, 527-8 (March 25, 1960).

Descriptions are given of the techniques of attaching resistance strain gauges to steel structures by epoxide strain gauge cement. Grinders are first used to obtain a smooth contour, any bad pits being filled by welding. The surface is then finished with 0 grade emery, but sand-blasting with 80-100 mesh grit has given satisfactory results and will be used in future. Waterproofing is normally done with epoxide cement or casting resin. Cable sealing glands are employed in cases where the leads have to be taken through the walls of a vessel, and multicore cable has proved very satisfactory under such conditions. Dummy gauges mounted on a separately waterproofed steel block immersed in a drum of water are used for temperature compensation, normally at the rate of ten compensating gauges per 96 active gauges. Uniselector switches with gold-plated contacts are used to connect the required gauges to the balancing and measuring equipment which is of normal type.

620.179.14

### 5927 INVESTIGATION OF AN ELECTRICAL NON-DESTRUCTIVE METHOD OF MEASURING THE DEPTH OF SURFACE HARDNESS IN FLAME-HARDENED STEELS.

J.A.Betts and J.P.Newsome.

Proc. Instn Elect. Engrs, Monogr. 372M, publ. April, 1960 (Vol. 107C, 265-71, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3234 of 1960.

620.179.152

### 5928 A NONDESTRUCTIVE METHOD TO DETECT PIPES AND CAVITIES IN HOT STEEL BLOOMS DURING THE ROLLING-PROCESS BY MEANS OF BETATRON, X-RAY-IMAGE-INTENSIFIER AND TELEVISION-SETUP.

W.Lueckerath, K.Fink and R.Flossmann.

Nondestr. Test., Vol. 18, No. 1, 27-34 (Jan.-Feb., 1960).

620.179.16

### 5930 ULTRASONIC INSPECTION OF WIRES. A.N. Butenko and V.S. Gumenyuk.

Priboostroenie, 1959, No. 6, (June). In Russian. English translation in: Instrum. Constr., 1959, No. 6, 16-19 (June).

A generating piezoelectric crystal, the wire under test and a receiving piezoelectric crystal are all immersed in an oil bath, an absorbing screen being inserted to prevent the vibrations generated from reaching the receiver without passing through the wire. When a defect occurs in the wire on the side facing the transmitter, the defect acts as a divergent lens and the intensity of the vibration at the receiver is less than when perfect wire is used. In practice, the dimensions of the wire are of similar order to the wavelength of the tested material, a frequency of 3.3 Mc/s being employed, for example, to test wire of 4 mm diameter. A comparative technique is employed with two separate transmitter-receiver units, one containing the wire under test and the other a reference specimen. A difference in the intensities of the sound received by the two instruments is indicated on a measuring instrument, and, by calibration with defects of known size, the scale on this instrument gives a direct indication of the magnitude of the fault.

A.C.Whiffin

620.179.6

### 5931 ELECTRODE POTENTIAL TESTING.

J.H.Bender, Jr., J.W.Dutil and P.D.Edwards.

Nondestr. Test., Vol. 18, No. 2, 99-102 (March-April, 1960).

Describes the development and some applications of a non-destructive test for ionic surface inclusions in metals, and for pores through an electroplate or cladding. The principle upon which this test method is based involves the electrode potential difference that exists between dissimilar ionic materials when immersed in a suitable electrolyte. The so-called "local action" that takes place in the vicinity of an inclusion or pore produces an electric field with considerable spatial distribution which may be rather easily detected.

- 5932 THE PROBLEM OF POSITIONING AND THE EFFECT-  
IVENESS OF INSULATED JOINT AND FLANGES FOR  
PROTECTION AGAINST ELECTROLYTIC CORROSION OF UNDER-  
GROUND METALLIC INSTALLATIONS. L.D.Razumov.  
Elektrichestvo, 1960, No. 2, 19-24 (Feb.). In Russian.

It is well known that the sectionalizing of underground trunking can reduce corrosion but it is pointed out that an increase in the number of sections can in some cases actually enlarge the danger zone. By considering that a generator exists at the joint, the leakage current which flows along the installation can be calculated and minimum corrosion conditions found. A method of approximately calculating these currents for a simple system is given, but direct measurements are recommended whenever possible. For complex networks, direct measurements are essential. In some cases it can be shown that conditions can be improved by fitting shunt resistors at joints.

J.S.Wilson

- 5933 CORROSION OF BURIED METALLIC PIPES BY STRAY  
ALTERNATING CURRENTS. C.Mounios.  
Rev. gen. Elect., Vol. 69, No. 4, 226-31 (April, 1960). In French.

The possibility of corrosion by a.c. is proved by several observations: solution of lead in drinking water due to an a.c. connection with the water pipe; perforation of a gas pipe due to circulating a.c. Investigations show that corrosion by a.c. alone, without help by rectification, requires a very high current-density, of the order of 0.1 A/in<sup>2</sup>, with an efficiency, compared with d.c., of approx. 0.003. In some soils, containing nitrates or carbonates, the efficiency can reach 0.18. Some attention is required to avoid unexpected accidents.

H.R.J.Klew

- 5934 CATHODIC PROTECTION APPLICATIONS AT THE  
HANFORD WORKS. C.S.Bucholz.  
Trans Amer. Inst. Elect. Engrs II, Vol. 78, 394-9 (1959) = Applic. and Industr., No. 46 (Jan., 1960).

Outlines the conditions of soil and water at the Hanford Atomic Products Operation and its effects upon several installations before cathodic protection was used. Its successful application to a stainless steel pipeline is described, with the results after 12 yrs operation. Details are given of a recent installation in a large water-storage tank, and of the protection planned for a partially buried reactor shell. Experiments are described of corrosion prevention in retention basins carrying hot effluent, where the problem of square corners made protection difficult.

E.F.Hansford

## WELDING . SOLDERING

- 5935 WELDING EQUIPMENT USING TRANSDUCTORS.  
K.Kless and E.Renz.  
A.E.G. Mitt., Vol. 49, No. 10-11, 561-70 (Oct.-Nov., 1959). In German.

It is first described how improvements in welding metallurgy enabled a change from d.c. to a.c. systems. Existing welding standards require that the source of welding current has a specified regulation characteristic, and that the nominal value of the welding current shall be adjustable in about five steps. The published literature on welding control practice is reviewed including both manual and highly automated systems.

S.C.Dunn

- 5936 ELECTRON BEAM WELDING.  
M.E.Harper and E.G.Nunn.  
Brit. Weld. J., Vol. 7, No. 5, 331-6 (May, 1960).

A versatile vacuum-welding equipment using an electron bombardment heat source is described in relation to the factors that govern its design. The operation of this equipment is simple, and several of the welding techniques employed are discussed to illustrate the advantages of electron-beam welding over the more conventional methods.

- 5937 A NEW CONTROL SYSTEM FOR WELDING MACHINES.  
E.Rohloff.  
Siemens-Z, Vol. 33, No. 10, 621-2 (Oct., 1959). In German.

Welding timers serve to control the time duration of the successive operations which form the welding programme. They also control the magnitude of the welding current and the application

of electrode force. With Simatic components welding timers can be constructed for any desired programme. An example is given of a series spot-welding timer for timing four operations.

- 5938 PROJECTION WELDERS FOR MASS-PRODUCTION.  
F.Czech.  
Siemens - Z., Vol. 34, No. 4, 236-8 (April, 1960). In German.

On account of the various methods by means of which the current and the electrode force can be concentrated, projection welding affords many advantages over conventional resistance welding. By employing electrodes of a special shape or electrodes with different thermal conductivity, it is frequently possible to satisfactorily complete even difficult welding jobs. A description is given of some of the applications of projection welders.

- 5939 APPLICATION OF ELECTRO-SLAG WELDING.  
A.M.Horsfield.  
Brit. Weld. J., Vol. 7, No. 5, 337-41 (May, 1960).

The electro-slag welding process is described and compared with other welding processes, particularly submerged-arc. Requirements of filler materials and fluxes are given and their relationship with weld metal quality are discussed. It is shown that for most structures the mechanical properties of electro-slag weld metal are more than adequate if it is normalized after welding and that in many cases "as-deposited" weld metal is quite satisfactory. It is shown that the electro-slag process offers important economies in those industries where heavy sections have to be fabricated.

- 5940 SEMI-AUTOMATIC WELDING WITH FINE WIRES.  
R.V.Brimble, J.A.Lucey and D.B.Tait.  
Brit. Weld. J., Vol. 7, No. 5, 342-52 (May, 1960).

Recent developments in equipment to provide alternative methods of feeding fine wires down to 0.20 in dia. for the welding of thin aluminium alloys, steel, stainless steel, and copper alloys are described. Investigations into metal transfer with short-circuiting arcs have shown that two distinct types of transfer can occur; (1) dip transfer in which the electrode tip dips into the pool of molten metal; (2) droplet dip transfer in which a droplet forms on the end of the electrode before short-circuiting to the plate. The development of slope-controlled power sources is mentioned. Some typical applications of the techniques are illustrated.

- 5941 ARGON ARC WELDS IN VACUUM TUBE TECHNIQUE.  
See Abstr. 5089

- 5942 SELF-ADJUSTING CONTROL SYSTEM FOR ELECTRIC  
PIPE-WELDERS. A.B.Chelyustkin and V.A.Ivanov.  
Elektrichestvo, 1960, No. 2, 13-18 (Feb.). In Russian.

The control system proposed allows automatic optimization of the operating point due to variations in the external conditions. Applying it to an electric resistance welder, pipes of different diameter and thickness, as well as of material having different resistance, can be handled simultaneously. While the simple control system would regulate the weld temperature, the self-adjusting system also correlates the variations in temperature with other measured parameters, i.e. wall thickness, and makes corresponding adjustments to the regulator settings. The determination of system parameters and a description of the transient behaviour are presented.

B.Dentskevich

- 5943 SPRAYED METAL COATINGS FOR ABRASION,  
CORROSION, AND OXIDATION RESISTANCE. G.R.Bell.  
Brit. Weld. J., Vol. 7, No. 5, 305-11 (May, 1960).

- 5944 SPRAYED METAL COATINGS.  
G.A.Curson.  
Brit. Weld. J., Vol. 7, No. 5, 312-17 (May, 1960).

Discusses the development of metal spraying and the types of equipment at present in commercial use that mainly spray the metal in either powder or wire form.

- 5945 HARD FACING WITH PLASMA SPRAY GUNS.  
E.A.Gerhold.  
Brit. Weld. J., Vol. 7, No. 5, 327-30 (May, 1960).

Reviews the various methods of obtaining plasma conditions suitable for flame spraying and briefly describes the principles and operation of a new plasma flame spray gun, and some of the materials successfully sprayed by it.

## LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Agric. horticult. engng Abstr.

Agricultural and Horticultural Engineering Abstracts.  
British Society for Research in Agricultural Engineering, National  
Institute for Agricultural Engineering, Wrest Park, Silsoe, Beds.

Defence Sci. J.

Defence Science Journal  
Defence Research and Development Organisation, Ministry of Defence,  
Government of India, New Delhi.

Meteorol. geostrophys. Abstr.

Meteorological and Geostrophysical Abstracts (Formerly: Meteorological  
Abstracts)  
The American Meteorological Society, 45 Beacon Street, Boston, Mass.

### NEW JOURNAL

Instn Engrs, Austral., elect. mech.  
Engng Trans.

Institution of Engineers, Australia, Electrical and Mechanical Engineering  
Transactions.  
Institution of Engineers, Australia, Science House, Gloucester and Essex  
Streets, Sydney. Vol. 1, No. 1, dated May, 1959.

### CHANGE OF TITLE

Meteorol. Abstr.

Meteorological Abstracts.  
Title changed to: Meteorological and Geostrophysical Abstracts (Meteorol.  
geostrophys. Abstr.) with issue dated Jan., 1960.

## ERRATA

Abstr. 3202 (1960) line 2: for "G.H.Scholten" read "C.G.H.Scholten".  
Abstr. 3287 (1960) line 3: for "M.S.Kohn" read "S.Kohn".  
Abstr. 3301 (1960) line 4: for "M.B.Hochart" read "B.Hochart".  
line 5: for "78-81" read "72-81".  
Abstr. 3340 (1960) line 3: for "M.B.Fernier" read "B.Fernier".  
Abstr. 3520 (1960) line 1: for "clasification" read "classification".  
Abstr. 4069 (1960) line 2: for "M.J.C.Fowell" read "E.J.C.Fowell".  
Author Index (June 1960) after Elias, P.: for "3659" read "3759".  
Author Index (June 1960) after Meyer, E.: for "3620" read "3630".  
Author Index (July 1960): for "Fowell, M.J.C." read "Fowell, E.J.C.".



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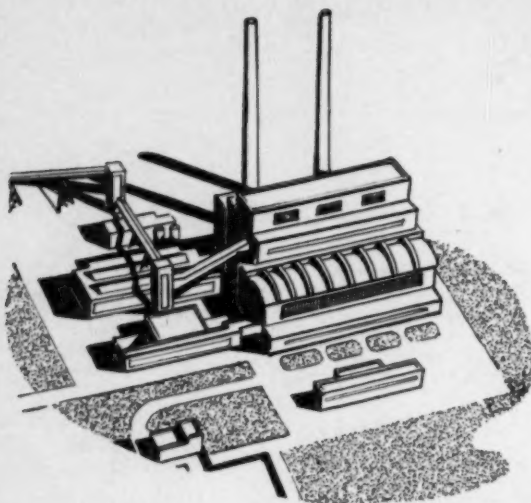
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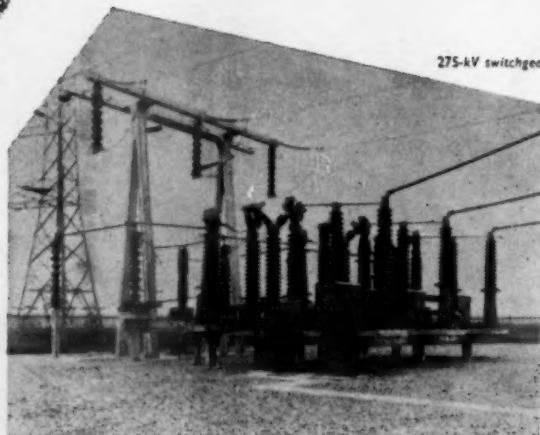


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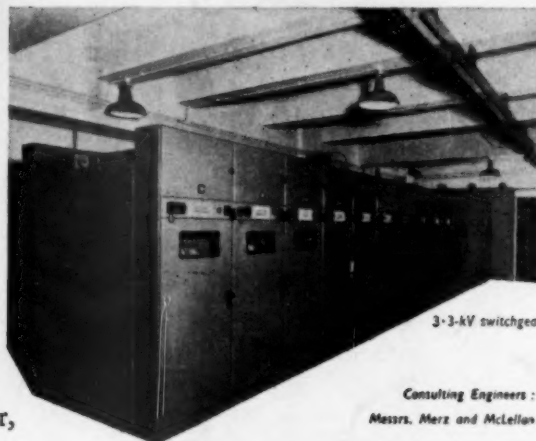
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